REPORT ON THE CHARACTERIZATION OF PARTICULATE AND GASEOUS EMISSIONS FROM THE COAL-FIRED COAL DRYER AT BULLMOOSE OPERATING CORPORATION,TUMBLER RIDGE, BRITISH COLUMBIA

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I DETAILED PLANT DESCRIPTION

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III STACK TRAVERSE DATA

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1 INTRODUCTION

In August 1984, the Technical Services Branch of EPS in cooperation with the Industrial Programs Branch and the Pacific Region in Vancouver carried out a series of air emission source tests on the wet scrubber stack of a coal-fired coal dryer located at the coal preparation plant operated by Bullmoose Operating Corporation near Tumbler Ridge, B.C.

These tests were conducted to characterize the particulate and gaseous emissions from an environmentally controlled, coal-fired thermal dryer and to evaluate sampling methodologies for the identification of trace organic emissions. Stack samples were collected to determine the emissions of particulates, selected heavy metals, gaseous HCl and trace organic compounds. Stack gas concentrations were also analyzed on a continuous basis for sulfur dioxide, nitrogen oxides, carbon monoxide, total hydrocarbons and oxygen.

2 PROCESS DESCRIPTION

The dewatered cleaned coal from the wash plant is conveyed to an ENI-Model 12.5 stoker-fired thermal dryer which uses dryer product coal to provide the heat necessary to dry the coal from 13 to 6.5%. The firing rate of the furnace is approximately 3 tonnes per hour.

The hot gases exit the dryer body and pass through two dust cyclones which collect coarse coal particles and pass this material to the clean coal conveyer. Finer material exits the cyclones and passes through an exhaust fan to a wet venturi scrubber operating at approximately 250 kPa and using 6000 litres per minute of water to scrub the exiting gases. The scrubber effluent is pumped to the clean coal thickener and clarified water is returned for re-use in the scrubber. Scrubbed gases are vented through a mist elimination stack to the atmosphere. Figure 1 depicts the coal-fired dryer layout and process.

The dryer is rated at 390 tonnes clean coal per hour at 13% moisture and is designed to remove 27.5 tonnes per hour of moisture.

Process data gathered during the survey is attached in Table 1. Each sample run was observed from the wash plant control room and any unexpected delays or shutdowns in the process necessitated a stoppage in the sampling schedule. All stack monitoring was performed during normal operating conditions in the plant.

Clean coal samples were obtained during each sample run. A composite sample was made up from all the coal samples obtained and the analytical results are given in Table 2.

A more complete description of the wash plant and other associated plant operating variables are contained in Appendix I.

Figure 1 - Flowsheet - Coal-Fired Dryer Plant

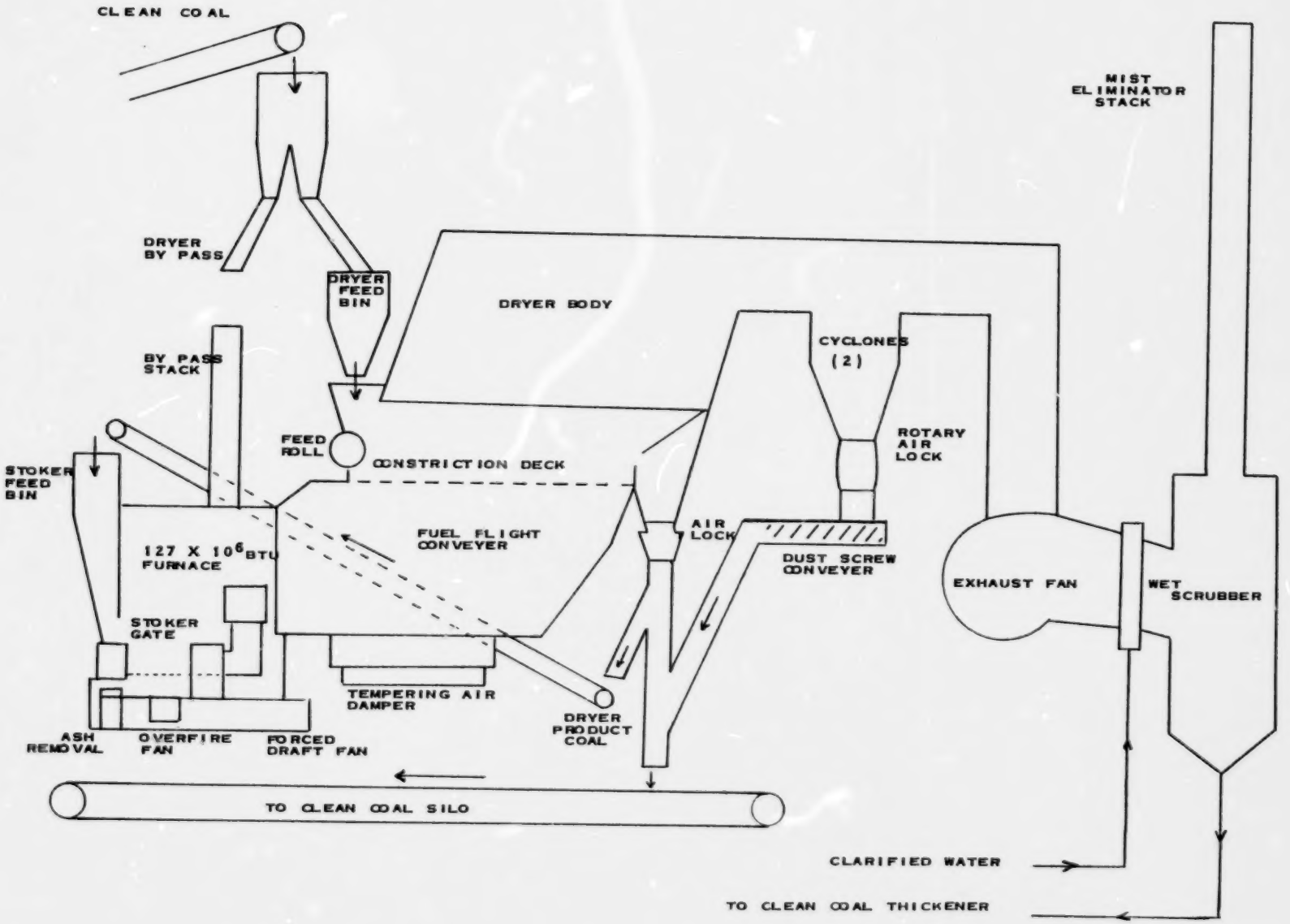


TABLE I SUMMARY OF PROCESS DATA

BULLMOOSE COAL PREPARATION PLANT - DRYER REPORT

General Data						
Run Number		1	3A	3B	4	5
Date (1984)		Aug. 29	Aug. 31	Aug. 31	Sept. 1	Sept. 2
Time		13:00 - 17:45	09:40 - 14:00	16:00 - 19:00	10:00 - 14:30	10:00 - 14:30
Met Coal Processed						
Tonnes		1682	959	628	1122	1295
Tonnes per Hour		354	221	209	249	288
Scrubber Characteristics						
Vacuum Pressure	(kPa)	9.4	9.5	10.1	9.6	9.8
Vacuum Diff. Pressure	(kPa)	6.0	5.5	--	5.5	5.5
Scrubber Water Pressure	(kPa)	235	240	--	250	250
Dryer Characteristics						
Dryer Inlet Pressure	(kPa)	0.23	0.22	0.25	0.23	0.21
Overdeck Pressure	(kPa)	2.50	2.30	2.20	2.30	2.50
Chamber Pressure	(kPa)	2.40	2.20	2.05	2.10	2.20
Fan Suction Pressure	(kPa)	3.60	3.40	3.30	3.40	3.50
Furnace Temp.	(°C)	510	450	325	405	425
Dryer Exhaust Temp.	(°C)	75	78	73	75	69
Dryer Body Temp.	(°C)	--	--	--	--	--

TABLE 2 ANALYTICAL RESULTS FOR COMPOSITE COAL SAMPLE

BULLMOOSE OPERATING CORPORATION	
Element or Parameter	%
Al	0.97
Ba	0.13
Ca	0.33
Fe	0.21
K	0.05
Mg	0.10
Na	0.06
P	0.04
Sr	0.01
Ti	0.11
LOF (1)	0.13
C	80.09
ash	8.61
moisture	0.60
volatile	25.77
fixed carbon	65.02
H	4.54
S	0.38
N	1.24
O (by difference)	4.54
heat value	77.98 (cal/g) 32.65 (mJ/kg)
S (pyritic)	0.05
S (organic)	0.33

(1) Note: LOF loss on fusion

3 TEST SITE

The sampling site was located indoors at the top floor of the dryer building. Samples were extracted from the stack using two ports located at 90° to each other. The sample for the continuous monitoring analyzers was extracted from a third port on the same level.

The measured stack diameter at the sampling level was 113 inches. As the sampling site did not meet the criteria of 8 stack diameters downstream of any flow disturbances, the total number of sampling points were increased from 32 to 48.

4 TEST SCHEDULE

A total of ten valid tests were completed by the Pollution Measurement Division during the period 29 August to 2 September, 1984. The sampling schedule is shown below.

SAMPLING SCHEDULE

Date (1984)	Run Number	Sampling Duration (min)
August 29	Dioxin/Furan - 1	240
	Part - 1	240
August 30	Dioxin/Furan - 2	240
	Part - 2 (Invalid)	240
August 31	Dioxin/Furan - 3	240
	Part - 3A	240
	Part - 3B	144
September 1	PAH's/PCB's - 1	240
	Part - 4	240
September 2	PAH's/PCB's - 2	240
	Part - 5	240

5 SAMPLING METHODS

5.1 Particulates/Heavy Metals/HCl

The standard reference method for particulates was used for the determination of particulates, heavy metals and gaseous chlorides. Particulate loadings and heavy metal emissions were determined from the front-half washes and loaded glass fibre filters. Gaseous HCl was determined from the distilled water in the first two impingers.

A sample of stack gas was extracted from the stack using a 10 1/2 foot glass-lined probe. Sampling was conducted isokinetically at each point along two traverses perpendicular to each other. Each traverse consisted of 24 points sampling five minutes at each point for a total sampling duration of 240 minutes. Leak checks were performed at the beginning and at the end of each traverse.

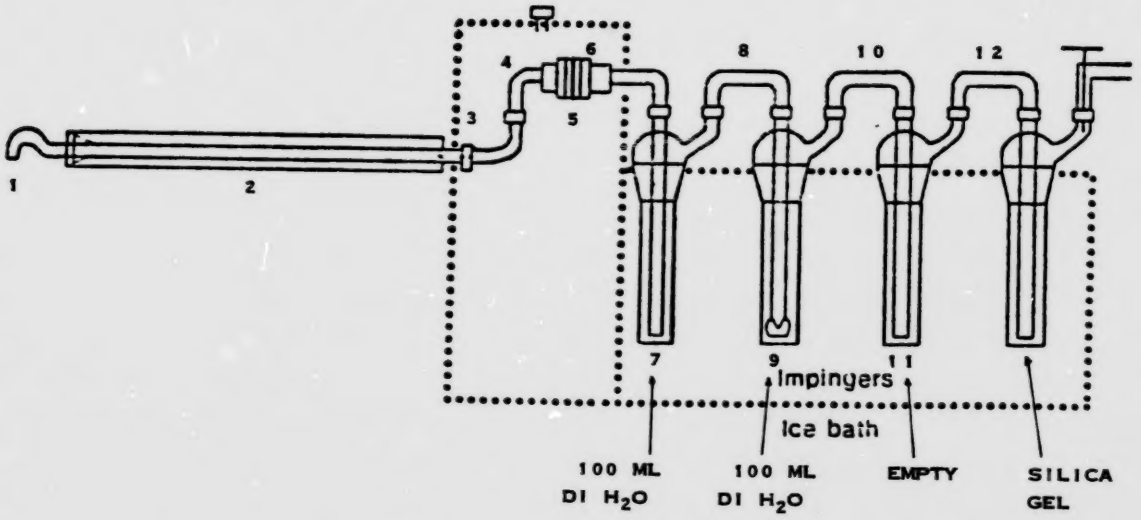
Upon completion of sampling, the probe and filter were disconnected from the sampling train and all openings sealed on-site to avoid sample loss or contamination. Particulates were quantitatively recovered from the nozzle, probe and front-half of the filter holder by brushing with acetone. All these washings were stored in one container. The filter was carefully removed from the filter and carefully placed into a petri dish which was immediately sealed. The distilled water impinger solutions were transferred to a clean bottle. All samples were labelled and shipped to Ottawa. The particulate sampling train and the sample recovery and partitioning procedures are shown in Figure 2.

Following gravimetric determination, the front-half wash residues and filters were passed to the Analytical Services Division (ASD) for heavy metals analysis. Impinger solutions were analyzed for chloride ion.

5.2 Dioxins, Furans, PAH's and PCB's

The Modified Method 5 (MM5) train was used for the collection of organic compounds. This train is widely accepted for sampling organics with boiling points above 100°C. In this train, particulate matter was collected on a glass fibre filter. Gaseous organics were trapped in a single sorbent tube containing Amberlite XAD-2, a styrene resin. As the temperature of the resin must be maintained below 20°C for optimal efficiency, the hot gases leaving the heated filter enclosure were cooled by passing them through a water-cooled condenser. Condensate formed in the cooling coil percolated through the resin bed and was collected in a condensate bottle. An impinger containing ethylene glycol was inserted downstream of the XAD-2 to check for breakthrough of

Figure 2 - Particulates/Heavy Metals/HC1 Train and Recovery Procedures



	CONTAINER OR SAMPLE	COMPONENTS	RECOVERY PROCEDURE
FRONT HALF	1	1, 2, 3, 4	WASH AND BRUSH WITH ACETONE RINSE WITH ACETONE
	2	5	REMOVE FROM FILTER HOLDER AND REPLACE IN ORIGINAL PETRI DISH AND SEAL
BACK HALF	3	7, 9	DUMP CONTENTS INTO CONTAINER
		6, 7, 8, 9, 10, 11, 12	RINSE WITH DH_2O

organics through the resin tube. For the PAH/PCB runs, a second glycol impinger was added. The resin tubes were covered with aluminum foil during sampling and storage to prevent any possible photodegradation of the trapped organics. A schematic of the organic train is illustrated in Figure 3.

Prior to the test program, all train glassware, amber storage bottles, Teflon lid liners, glass wool and aluminum foil were cleaned following a rigorous cleaning procedure. The XAD-2 resin was pre-cleaned by extracting with distilled water, methanol, methylene chloride and hexane. The resin, glass fibre filters and solvents used for recovery were screened for contamination prior to the survey. All recovery chemicals were of distilled-in-glass grade. All glassware openings were sealed with pre-cleaned glass caps or hexane-rinsed aluminum foil.

At the site, only Teflon wash bottles were used for sample recovery. Glassware joints were sealed by wrapping the ball joints with Teflon tape as vacuum greases are not permitted for organic sampling. Prior to the start of each run, all train glassware was rinsed once with hexane.

Following each test, the sampling train was partially disassembled on-site and all openings were sealed with pre-cleaned caps or rinsed foil. The train was recovered in a makeshift lab. Basically the recovery procedure involved the brushing and rinsing of most of the train glassware with acetone and hexane. Liquid samples were stored in pre-cleaned amber bottles to prevent photodegradation. Bottle lids were lined with pre-cleaned Teflon sheets. Amberlite tubes were capped and re-wrapped in aluminum foil. The samples were partitioned to permit evaluation of the sorbent efficiency and rinsing procedures. Following recovery, all samples were refrigerated and kept on ice until the samples were passed on to the ASD. The sample partitioning and recovery procedures are detailed in Figure 4.

In addition to the train samples, a number of field reagent and blank train samples were submitted as quality control checks. Reagent blanks included HPLC water, acetone, hexane and XAD-2. Filter blanks were also submitted for organics screening. Two blank trains were assembled at the site - one for dioxins/furans and the other for PAH's/PCB's. The blank trains were treated in the same manner as the sample train except that no stack gases were sampled. However, a volume of ambient air, equal to that drawn during the pre- and post-traverse leak checks was drawn through the blank train. Essentially, the blank train serves as a check for background levels of organics originating from ambient air, handling and contaminated reagents or chemicals.

Figure 3 - Dioxins/Furans & PAH/PCB Sampling Train

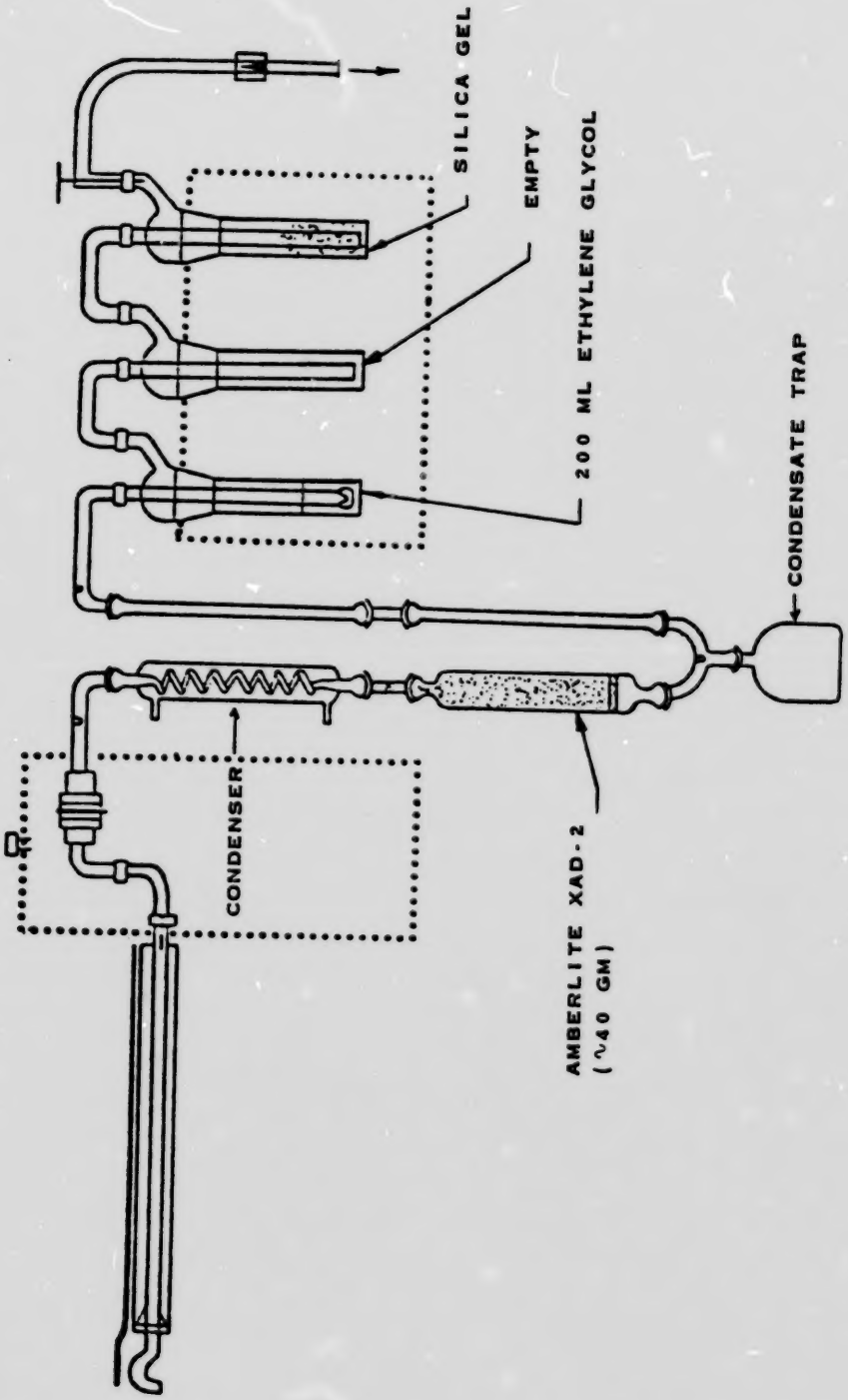
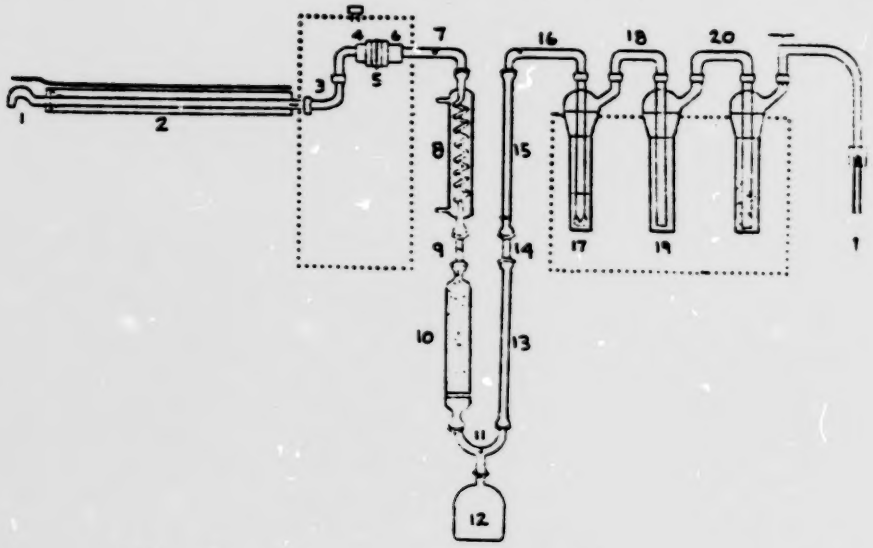


Figure 4 - Sample Partitioning & Recovery Procedures - Organic Train



CONTAINER OR SAMPLE	COMPONENTS	RECOVERY PROCEDURE
1	1, 2, 3, 4	WASH & BRUSH WITH ACETONE(A) AND HEXANE(H)
	5	FOLD CAREFULLY AND IMMERSE IN CONTAINER
2	1, 2, 3, 4	RINSE TWICE WITH A AND H
3	6, 7, 8, 9	SOAK WITH A AND H AT LEAST 5 MINUTES EACH. RINSE TWICE WITH A AND H
4	10	CAP ENDS, KEEP WRAPPED IN AL FOIL
5	12	DUMP CONTENTS OF TRAP INTO CONTAINER
	11, 12	RINSE TWICE WITH A AND H
6	17	DUMP IMPINGER CONTENTS INTO CONTAINER
	17	RINSE WITH ETHYLENE GLYCOL AND DH_2O
	13, 14, 15, 16	RINSE WITH ETHYLENE GLYCOL AND DH_2O
	18, 19	RINSE WITH DH_2O
7	6, 7, 8, 9	RINSE TWICE WITH A AND H
8	11,12,13,14,15 16,17,18,19,20	RINSE TWICE WITH A AND H

5.3 Continuous Monitoring

Continuous monitoring was conducted for SO_2, NO_x, CO, THC (lighter fractions) and O_2. A list of the analyzers that were used during the test program are described in the following table.

DESCRIPTION OF ANALYZERS

Compound	Analyzer	Range	Detection Principle
SO_2	WRI 721A	0-2000 ppm	NDUV
NO_x	Teco 10AR	0-250 ppm	Chemiluminescence
CO	Bendix 8501	0-1000 ppm	NDIR
THC	Beckman 400	0-1000 ppm	Cold FID
O_2	Teledyne 320	0-25%	Electrochemical

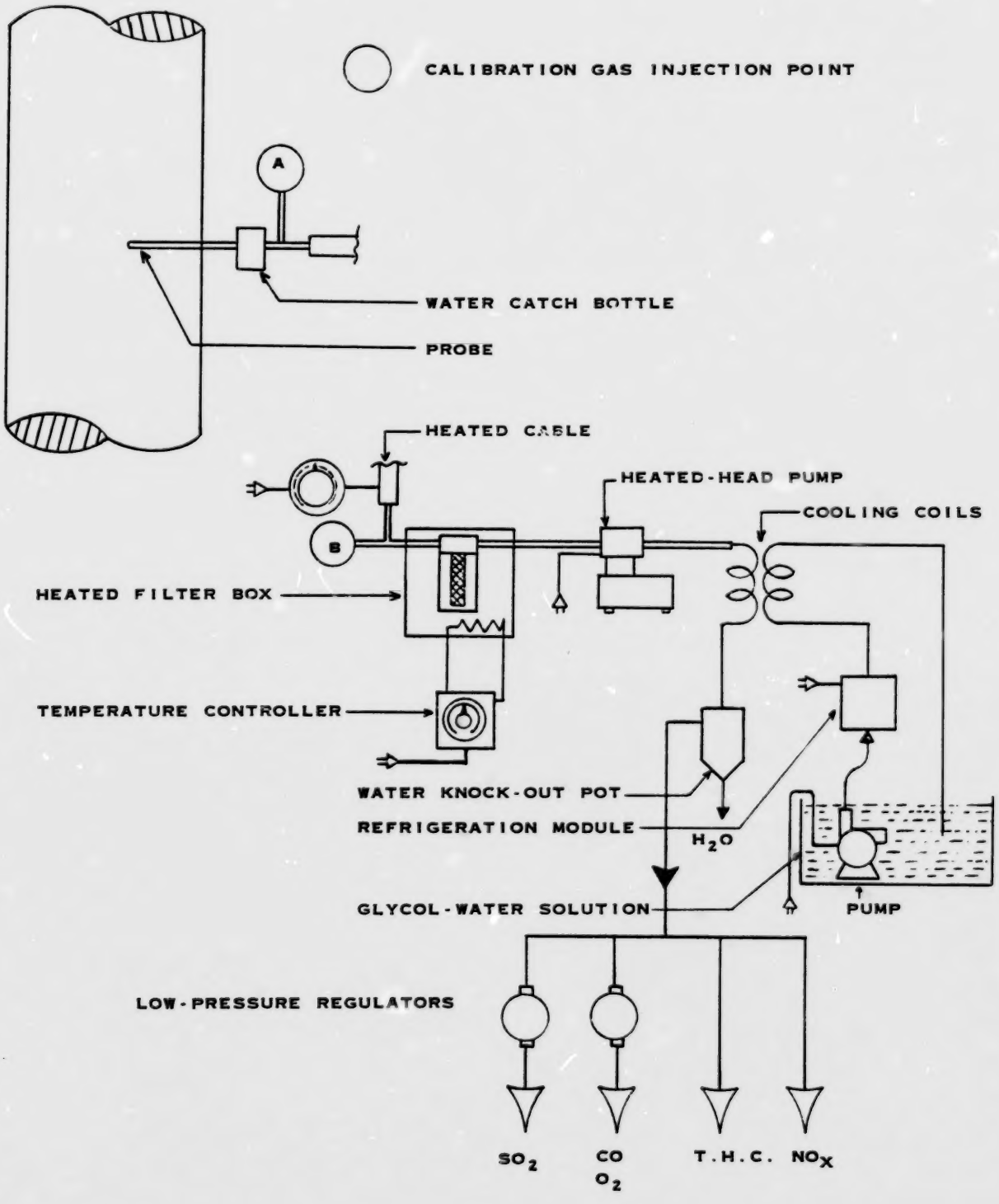
A diagram of the conditioning system employed during the study is presented in Figure 5. The purpose of the conditioning system was to remove all forms of water and particulate matter from the flue gas prior to its introduction to the analyzers. The presence of water droplets from the drying plant stacks required some modification to the standard sample conditioning technique. The in-stack filter normally used to filter particulates was removed to prevent blinding and a water catch bottle was inserted between the probe exit and heated sample line. Some particulates were also removed in the first water trap. The sample gas was then drawn through a heated sample line into a heated filter box to remove the rest of the particulate matter. Finally, the sample gas was cooled to about 7°C in a countercurrent heat exchanger to remove more water.

Calibration of the various analyzers was carried out by injection of commercially available gas mixtures. The oxygen monitor was calibrated with ambient air. A list of the calibration gases used during the survey is shown in the following table.

LIST OF CALIBRATION GASES

Component	Concentration (ppm)
SO_2 in N_2	1900
NO in N_2	500
CO in air	205
HC in air	100
O_2	ambient air

Figure 5 - Continuous Source Monitoring System



Calibration gases were injected at two points in the system. Injection at Point "B" (Figure 5) offered a quick calibration of the conditioner and analyzers. Although this type of procedure is simple and does not consume large quantities of calibration gases, calibration was also conducted across the whole system, i.e., injection at Point "A". This procedure is the correct and preferred method of calibrating a system but is not widely used due to the inherent high consumption of calibration gases. Calibration at Point "A" was conducted twice during the survey while injection at Point "B" was carried out twice a day.

Leak checks were conducted prior to and at the end of each test by capping the water knock-out bottle and subjecting the system to a vacuum of 23 inches of mercury. The sample pump was then turned off and the vacuum drop noted for two minutes. Any drop in vacuum during this period indicated a leak in the portion of the system under vacuum.

All the signals from the analyzers were recorded on a multi-point recorder. Usually a data logger is used for collecting data, however, the dusty conditions at the site precluded the use of this instrument.

5.4 Process Streams

Process samples were also collected during the sampling runs. Four process streams were sampled:

1 - scrubber inlet water
2 - scrubber outlet water
3 - coal feed to dryer
4 - ash.

Four to five grab samples were taken during each test at equal intervals from each of the four process streams. Typically a 5-gallon pail of sample was collected for each stream every run. At the end of each run, each sample was well mixed and a representative portion taken and stored in a clean glass mason jar. All process samples were returned to Ottawa. In Ottawa, a composite coal sample was made up from the five daily coal samples and submitted to two labs for multi-element, proximate and ultimate analysis. The scrubber solutions and the ash samples were not analyzed due to a lack of funds.

6 ANALYTICAL METHODOLOGIES

All the samples from the organic trains were submitted to the ASD for dioxin, furan, PAH and PCB analysis. A description of the extraction procedures for the different sample matrices, clean-up methods, screening and analysis are outlined in Appendix II.

The loaded glass fibre filters and the front-half wash residues from the first four runs were forwarded by the ASD to Bondar-Clegg, a local laboratory, for heavy metals analysis. The filter and residue from the fifth particulate/heavy metals run were sent to NEA, Inc. (Beaverton, Oregon) for the analysis of heavy metals, organic and elemental carbon. Impinger solutions from the particulate trains were analyzed by the ASD for chloride ion using ion chromatography.

The coal composite was submitted to Energy, Mines and Resources (EM&R) and Bondar-Clegg for multi-element, proximate and ultimate analysis. In addition, a National Bureau of Standards (NBS) reference coal sample was sent to each of these labs to determine accuracy and precision. All inorganic results including comparisons between different labs are detailed in an internal ASD report contained in Appendix II.

7 RESULTS

7.1 Particulates/HCl

The summary of the particulate results is given in Table 3. Particulate concentrations ranged from 46.2 to 62.4 mg/m^3 or 0.020 to 0.027 grains/ft^3. Average concentration was 49.8 mg/m^3 or 0.022 grains/ft^3. Emission rates varied between 9.1 and 12.9 kg/h or 219 to 311 kg/day. Except for Run P-3B, all emission results were very consistent. The data is summarized in the following table.

SUMMARY OF PARTICULATE DATA

	Range	Mean	Standard Deviation
CONCENTRATION			
mg/m^3	46.2 - 62.4	49.8	7.3
grains/ft^3	0.020 - 0.027	0.022	0.003
EMISSION RATES			
kg/h	9.1 - 12.9	10.4	1.6
kg/day	219 - 311	250	37

Gaseous hydrogen chloride was also determined for each run by measuring the chloride ion concentration in the distilled water from the impingers. Hydrogen chloride concentrations were very low ranging between 0.012 and 0.030 ppm. The average concentration was 0.019 ppm.

7.2 SO_2, NO_x, CO, THC and O_2

The continuous monitoring results for SO_2, NO_x, CO, THC and O_2 are given in Table 4. The daily concentrations for each pollutant represent averages of the 15-minute averages. Range, mean and standard deviation of the daily values for each constituent are summarized in the following table.

TABLE 3 SUMMARY OF PARTICULATE RESULTS

BULLMOOSE OPERATING CORPORATION - DRYER STACK

GENERAL DATA					
Run Number	P-1	P-3A	P-3B	P-4	P-5
Date (1984)	Aug. 29	Aug. 31	Aug. 31	Sept. 1	Sept. 2
Time	1256-1747	0944-1407	1632-1928	1009-1430	1006-1430
Test Duration (min)	240	240	144	240	240
Total Sample Vol (m^3)	4.037	4.044	2.423	4.051	4.223
Isokineticity (%)	101.1	99.1	99.3	99.2	99.1
STACK GAS CHARACTERISTICS					
Average Velocity (m/s)	11.58	11.66	11.45	11.63	12.04
Flowrate (m^3/min)	3392	3464	3457	3471	3615
Temperature (°C)	42.6	40.0	37.5	39.6	40.0
Moisture (%)	9.51	8.49	7.55	8.18	8.37
Oxygen (%)	18.37	18.90	19.10	19.08	18.95
Carbon Dioxide (%)	2.47	1.77	1.80	1.74	1.95
PARTICULATE CATCHES					
Probe Wash (mg)	74.5	70.3	69.9	59.6	66.8
Filter (mg)	112.0	107.1	81.3	130.3	142.6
Total (mg)	186.5	177.4	151.2	189.9	209.4
PARTICULATE CONCENTRATION					
Total (mg/m^3)	46.21	43.87	62.40	46.88	49.60
Total ($grains/ft^3$)	0.020	0.019	0.027	0.020	0.022
PARTICULATE EMISSIONS					
Hourly (kg/h)	9.40	9.12	12.94	9.76	10.76
Daily (kg/day)	226	219	311	234	258

- All volumes given at dry standard conditions (25°C and 101.3 kilopascal)
- O_2 and CO_2 expressed on a dry basis
- Moisture - Saturation Value

TABLE 4 SUMMARY OF CONTINUOUS SO_2, NO_x, CO, THC AND O_2 RESULTS

BULLMOOSE OPERATING CORPORATION - DRYER STACK						
Run No.	1	2	3A	3B	4	5
Date (1984)	Aug. 29	Aug. 30	Aug. 31 (am)	Aug. 31 (pm)	Sept. 1	Sept. 2
Time	1500-1745	1015-1630	1000-1415	1630-1930	1015-1430	0930-1430
SO_2 (ppm)	11	12	11	12	14	10
NO_x (ppm)	68	55	53	44	54	48
CO (ppm)	630	450	370	400	520	570
THC (ppm)	---	63	43	50	54	42
O_2 (%)	18.9	18.7	18.9	19.1	19.0	18.8

All values represent averages of 15-minute averages

SUMMARY OF CONTINUOUS MONITORING CONCENTRATIONS

	Range	Mean	Standard Deviation
SO_2 (ppm)	10-14	11.7	1.4
NO_x (ppm)	44-68	53.7	8.2
CO (ppm)	370-630	490	101
THC (ppm)	42-63	50.4	8.6
O_2 (%)	18.7-19.1	18.9	0.1

7.3 Heavy Metals

The stack gas concentrations and emission rates for Al, Ca, Fe, K, Mg, Na, P, S and Si are given in Table 5. Heavy metal results for run P-5 were not available at the time of writing. On average, silicon represented the largest component of the elements analyzed followed by sulfur, iron, aluminum and calcium. Potassium was the smallest component. A summary of the mean and standard deviation for each metal is given in the following table.

SUMMARY OF HEAVY METAL DATA

	CONCENTRATION (mg/m^3)		EMISSION RATE (g/h)	
	Mean	Standard Deviation	Mean	Standard Deviation
Al	0.53	0.27	109	56
Ca	0.49	0.52	102	108
Fe	0.66	0.40	137	82
K	0.04	0.03	9	6
Mg	0.09	0.04	17	8
Na	0.09	0.04	19	7
P	0.22	0.08	45	17
S	0.69	0.57	143	119
Si	2.23	1.74	462	362

TABLE 5 SUMMARY OF HEAVY METAL RESULTS

BULLMOOSE OPERATING CORPORATION - DRYER STACK										
	Run No. P-1		Run No. P-3A		Run No. P-3B		Run No. 4		Average	
	mg/m^3	g/h	mg/m^3	g/h	mg/m^3	g/h	mg/m^3	g/h	mg/m^3	g/h
Al	0.44	89.2	0.43	89.4	0.92	191.8	0.32	65.8	0.53	109
Ca	0.37	75.6	0.15	31.9	1.26	261.9	0.19	39.6	0.49	102
Fe	0.29	59.5	0.62	128.0	1.22	252.5	0.52	108.5	0.66	137
K	0.08	17.1	0.02	5.1	0.03	6.9	0.02	5.1	0.04	9
Mg	0.08	16.1	0.14	28.3	0.06	12.0	0.06	11.8	0.09	17
Na	0.12	25.2	0.04	9.3	0.10	20.6	0.10	21.6	0.09	19
P	0.13	27.2	0.32	66.8	0.24	50.5	0.17	36.0	0.22	45
S	0.05	10.1	0.78	161.9	1.42	293.6	0.50	103.9	0.69	142
Si	0.82	166.9	1.54	320.2	4.77	988.7	1.78	371.2	2.23	462

Concentrations expressed at dry standard conditions (25°C and 101.3 kilopascal)
Results for Run P-5 are not available

7.4 Organics

7.4.1 Dioxins/Furans. The dioxin and furan emission results for three runs are presented in Table 6. Dioxins and furans were detected in all three runs. The average dioxin and furan concentration and emission rates are given in the following table.

SUMMARY OF DIOXIN AND FURAN DATA

	Concentration (ng/m^3)	Emission Rate ($\mu g/h$)
Dioxins	2.39	508
Furans	0.33	69

No particulate/gaseous split or train efficiency data was available for these runs since all the sample extracts from each run were combined. This was done to increase the detectability of the dioxins and furans for each run. Initial analyses performed with the GC/MSD did not show detectable levels (2-5 ng per isomer) in any of the train sample extracts for each run. Hence it was decided to combine the extracts for each run and to use a more sensitive analytical technique (GC/MS, detection limit 0.1 to 0.5 ng per isomer). As a result of these two changes dioxins and furans were detected in each run. The majority of the dioxins were found in the hepta and octa isomer groups whereas all the furans were found in the tetra group.

7.4.2 Polyaromatic Hydrocarbons. Two runs were conducted for polyaromatic hydrocarbons (PAH's), as described in Table 7. The same train was also used for the determination of PCB's. The concentration and emission rate for each compound are shown in Table 8. In total, 25 compounds were determined. These ranged from molecular weights of 152 to 279. In both runs, the majority of the PAH's were found in the lower molecular weight groups, i.e., acenaphthylene to phenanthrene. No PAH's were detected in the higher molecular weight groups, i.e., perylene to anthanthrene.

The average PAH concentrations for the first and second runs were 4.41 and 6.55 $\mu g/m^3$ respectively. Emission rates were 987 and 1487 mg/h respectively. Acenaphthene, fluorene, 2-ME-fluorene and phenanthrene accounted for 84% of the PAH's in the first run and 57% of the PAH's in the second run. Almost all the PAH's were found in the gaseous phase. No breakthrough of PAH's was detected into the back-up ethylene glycol impinger. PAH's were not detected in the blank train or the reagent blanks.

TABLE 6 SUMMARY OF DIOXIN AND FURAN RESULTS

BULLMOOSE OPERATING CORPORATION - DRYER STACK

GENERAL DATA			
Run Number	DF-1	DF-2	DF-3
Date (1984)	Aug. 29	Aug. 30	Aug. 31
Time	1300-1746	1018-1620	0946-1400
Test Duration (min)	240	240	240
Total Sample Vol (m^3)	4.163	4.328	4.217
Isokineticity (%)	101.4	97.5	101.4
STACK GAS CHARACTERISTICS			
Average Velocity (m/s)	11.87	12.43	12.10
Flowrate (m^3/min)	3483	3764	3523
Temperature (°C)	41.3	39.7	38.5
Moisture (%)	9.74	7.25	10.71
Oxygen (%)	18.37	18.74	18.90
Carbon Dioxide (%)	2.47	1.98	1.77
TRAIN CATCHES*			
Dioxins (ng)	6.7	4.7	18.8
Furans (ng)	3.0	0.6	0.5
CONCENTRATION			
Dioxins (ng/m^3)	1.61	1.09	4.46
Furans (ng/m^3)	0.72	0.14	0.12
EMISSION RATES			
Dioxins (µg/h)	336.3	245.3	942.4
Furans (µg/h)	150.6	31.3	25.1

- All volumes given at dry standard conditions (25°C and 101.3 kilopascal)
- O_2 and CO_2 expressed on a dry basis
- Saturation value is given for % moisture

* Train catches have been recovery corrected for the labelled isotope standards. No dioxins and furans were detected in the blank train and the reagent blanks

TABLE 7 SUMMARY OF TRAIN AND STACK DATA - PAH RUNS

BULLMOOSE OPERATING CORPORATION - DRYER STACK

GENERAL DATA

Run Number	PAH/PCB-1	PAH/PCB-1
Date (1984)	Sept. 1	Sept. 2
Time	1011-1430	1001-1429
Test Duration (min)	240	240
Total Sample Vol (m^3)	4.463	4.523
Isokineticity (%)	101.2	101.5

STACK GAS CHARACTERISTICS

Average Velocity (m/s)	12.79	12.82
Flowrate (m^3/min)	3738	3782
Temperature (°C)	39.0	39.2
Moisture (%)	10.29	10.31
Oxygen (%)	19.08	18.95
Carbon Dioxide (%)	1.74	1.95

- All volumes given at dry and standard conditions (25°C and 101.3 kilopascal)
- O_2 and CO_2 expressed on a dry basis
- Saturation value is given for % moisture

TABLE 8 SUMMARY OF PAH RESULTS

Compound	RUN PAH/PCB-1 Concentration ($\mu g/m^3$)	RUN PAH/PCB-1 Emission Rate (mg/h)	RUN PAH/PCB-2 Concentration ($\mu g/m^3$)	RUN PAH/PCB-2 Emission Rate (mg/h)
Acenaphthylene	0.24	52.77	0.25	57.70
Acenaphthene	1.30	291.47	1.28	290.98
Fluorene	1.10	246.24	1.03	233.29
2-ME-Fluorene	0.54	120.61	0.48	107.87
Phenanthrene	0.77	173.37	0.94	214.23
Anthracene	0.04	9.55	0.87	198.17
Fluoranthene	ND	ND	0.21	47.66
Pyrene	0.04	8.04	0.19	42.64
Benzo (A) Fluorene	0.08	17.59	0.11	25.09
Benzo (B) Fluorene	0.03	7.04	0.07	16.05
3-ME-Pyrene	ND	ND	0.10	23.08
Benzo (G,H,I) Fluoranthene	ND	ND	0.05	12.04
Benzo (A) Anthracene	0.06	13.07	0.13	30.10
Chrysene & Triphenylene	0.06	13.57	0.27	61.21
2-ME-Benzo (A) Anthracene	0.01	2.01	ND	ND
B (B) F & B (K) F	0.04	10.05	0.27	60.20
Benzo (E) Pyrene	0.05	11.06	0.17	37.63
Benzo (A) Pyrene	0.05	10.55	0.06	13.55
Perylene	ND	ND	ND	ND
ME-Cholanthrene	ND	ND	ND	ND
O-Phenylene Pyrene	ND	ND	0.07	15.05
Dibenzo (A,C) & (A,H) Anthracene	ND	ND	ND	ND
Benzo (B) Chrysene	ND	ND	ND	ND
Benzo (G,H,I) Perylene	ND	ND	ND	ND
Anthanthrene	ND	ND	ND	ND
TOTAL	4.41	986.99	6.55	1486.54

ND - not detectable
No PAH's were detected in the blank train and reagent blanks

7.4.3 Polychlorinated Biphenyls

Polychlorinated biphenyls were also determined from the PAH/PCB train samples. Since PCB's were detected in the blank train, namely the XAD-2, the amounts caught in the trains were corrected for the blank values. Significant amounts of PCB's were detected in the first glycol impinger indicating breakthrough of PCB's through the Amberlite XAD-2. However, none were detected in the second glycol-filled impinger. The majority of the PCB's were trapped in the gaseous phase.

The concentrations for the first and second runs were 343 and 40 ng/m^3 respectively. Emission rates were 76.9 and 9 mg/hr respectively. These results should be regarded as qualitative in nature due to suspected contamination in the field or the lab.

8 DISCUSSION

The test program was conducted to characterize the emissions from a coal-fired metallurgical coal dryer and to evaluate the effectiveness of the organic sampling train. No problems were experienced with the particulate/heavy metals/HCl train. There was mixed success with the various groups of organic compounds in the organic train. For the dioxins and furans, the extracts were combined to obtain a total for each run hence the particulate/gaseous split, scrubbing efficiency and effectiveness of the rinsing procedures cannot be assessed. No contamination problems were experienced as no detectable levels were found in the blank train samples and the reagent and adsorbent blanks. With respect to the PAH compounds in the PAH/PCB train, distribution data indicated good adsorption efficiency by the XAD-2 and effective rinsing procedures. No PAH's were detected in the condensate trap indicating good percolation efficiency. All blank train samples, reagent and resin blanks contained sub-detectable levels of PAH's. In the case of the PCB's, however, the results should be regarded as inconclusive due to the comparatively high levels of PCB's found in the blank train. Considering the complexity and different characteristics of the organic compounds analyzed, the organic sampling train was effective for collecting dioxins, furans and polyaromatic hydrocarbons.

APPENDIX I

DETAILED PLANT DESCRIPTION

BULLMOOSE COAL PREPARATION PLANT

Mine and Markets

Bullmoose Operating Corporation, a subsidiary of Teck Corporation of Vancouver, British Columbia, commissioned the surface mine and preparation plant in 1983 to supply metallurgical coal to the Japanese steel mills and steam coal to various overseas markets.

Coal is mined in a multi-bench operation on the eastern slopes of the Rocky Mountains in North East British Columbia. After cleaning, it is trucked 35 km (20 miles) to a rail loadout on British Columbia Railway's new electrified branch line near the new town of Tumbler Ridge. Unit trains move coal southwest through the continental divide to the main CN Rail line at Prince George, and from there to the new Ridley Island port near Prince Rupert, British Columbia, for shipment.

Coal Preparation Plant

Considerable modifications were necessary at the various coal preparation plants built in the Rocky Mountains in the 1970s, and these experiences were used to design this facility.

The run-of-mine coal is fed by the mine haul trucks, or by a front end loader reclaiming from a stockpile, into a 350 tonne hopper. It is then fed to a Bradford rotary breaker. This reduces the coal top size to 38 mm and rejects hard waste.

The 38 mm x 0 raw feed coal is conveyed to a 4000 tonne raw coal silo from which it is conveyed at a controlled rate to the cleaning plant. Coarse coal 38 mm x 0.6 mm is cleaned by conventional heavy medium (magnetite)

cyclones. After removal of medium by means of sieve bends and drain and spray screens, the cleaned coal is dewatered by centrifuges.

Three Stage Fines Cleaning

The fine coal (0.6 mm x 0) slurry underflow, from the desliming sieve bends and screens, is pumped to two stage water-only washing cyclones. The primary stage overflow passes over vibrating sieve bends to recover the 0.6 x 0.15 mm cleaned: this is dewatered using screen bowl centrifuges. 0.15 mm x 0 slurry underflow from the vibrated sieve bends flows to the froth flotation cells; the float product is dewatered using rotary vacuum disc filters.

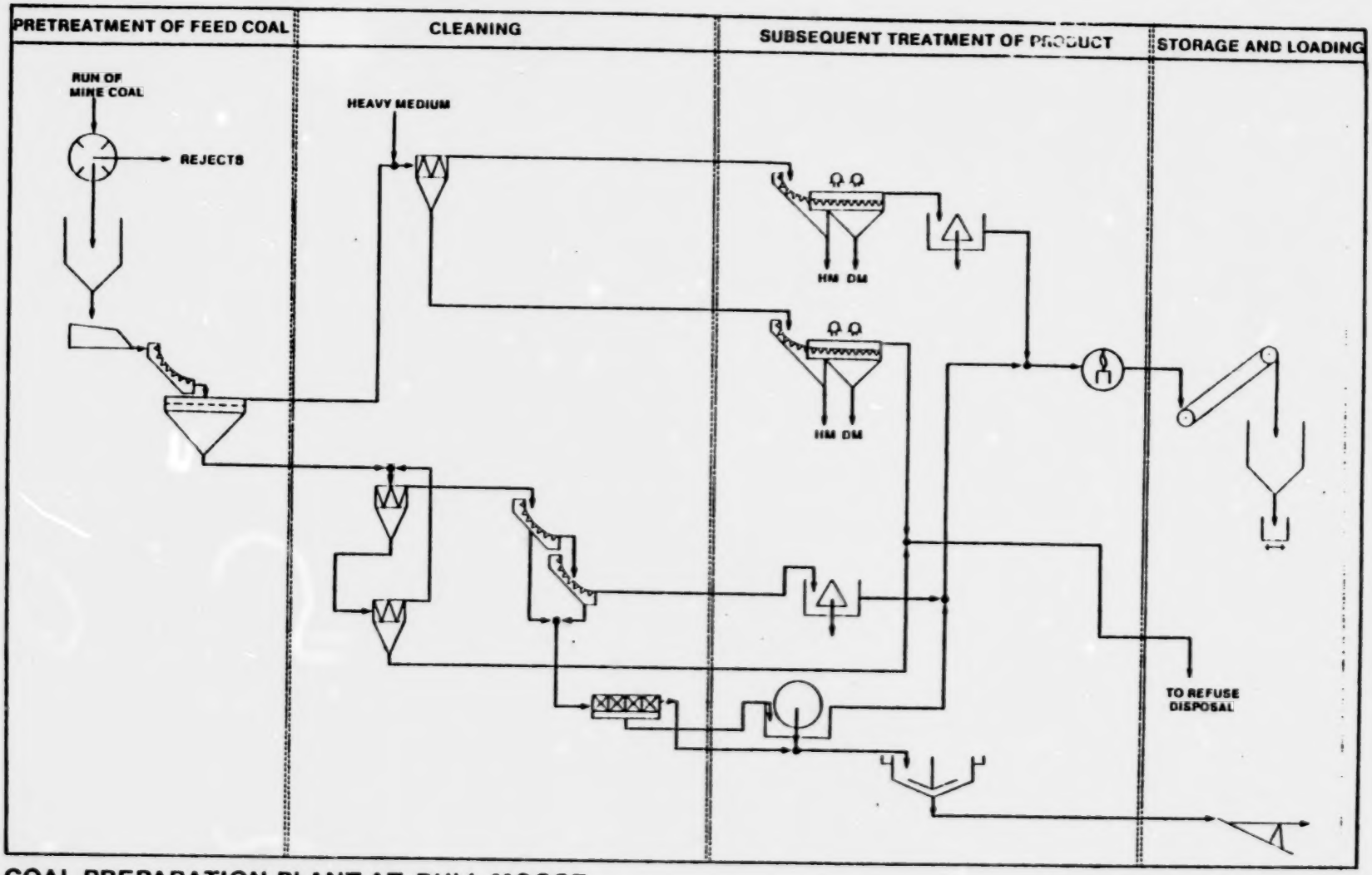
Underflow from the primary water-only washing cyclones is diluted with wash-water and pumped to the secondary water-only washing cyclones. Underflow from this second stage is rejected, whilst the overflow is returned to the primary stage feed sump.

Clean Coal Drying

The products from the centrifuges and disc filters are further dewatered using an ENI Fluid Bed Dryer. This is a stoker fired unit which utilizes part of its coarse product as fuel.

Thermal Coal

Lower grade or partially oxidized coal is segregated in the mining operation and batched through the plant on a one-week per month basis.

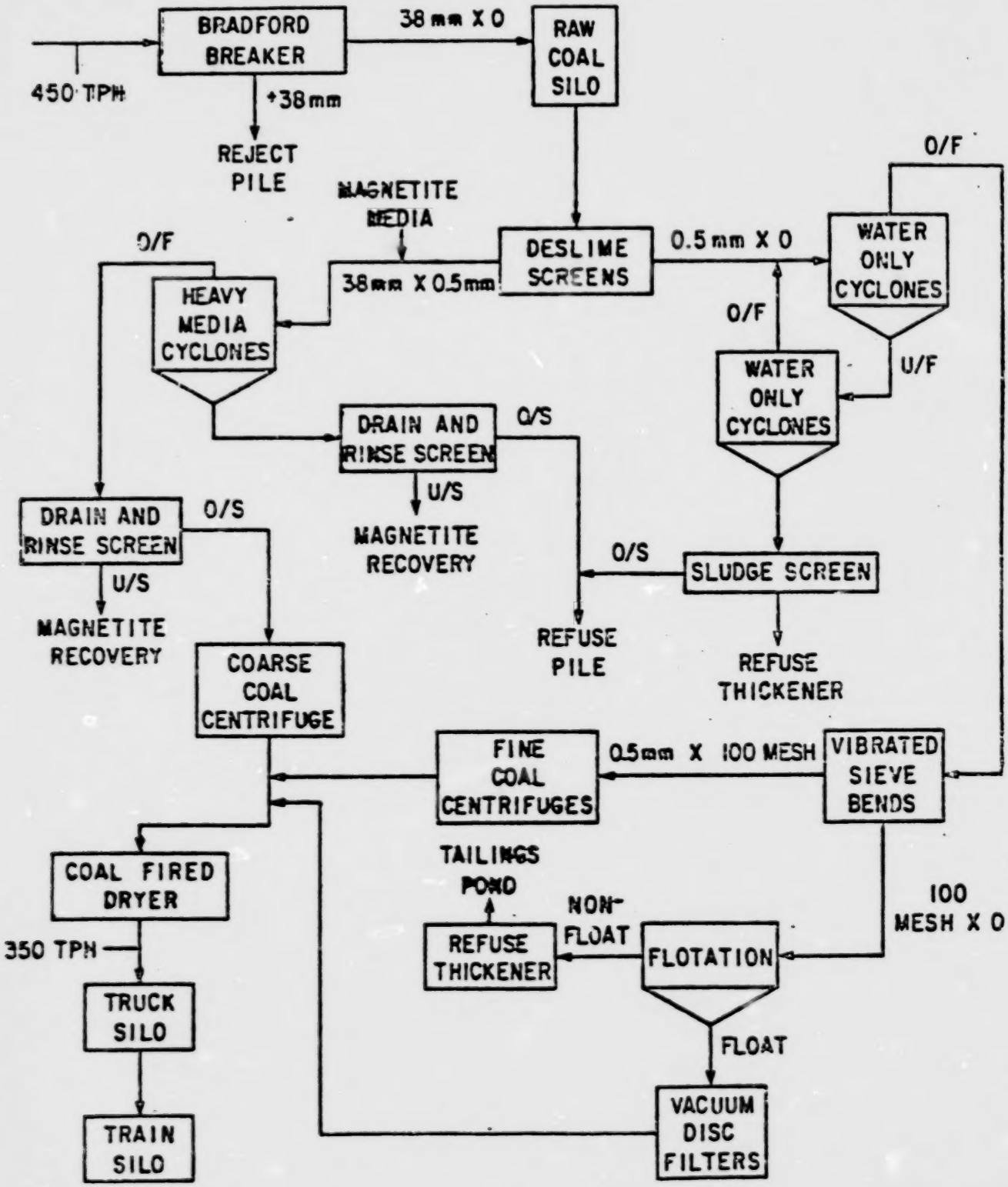


COAL PREPARATION PLANT AT BULL MOOSE.

BULLMOOSE COAL PREPARATION PLANT

Plant Location	Wolverine area, North East B.C.
Coal field	Peace River
Coal rank ISO	4
ASTM	Medium volatile bitiminous
Commissioned	1983
Feed capacity (tonnes per hour)	450
Plant recovery, %	-
Clean coal production (10^6 tonnes per year, 83)	1.7 metallurgical 0.3 thermal (intermittent)
Typical % minus 0.6 mm	30
Typical clean cool analysis	
% Ash	9.5
% Total moisture	8.0
% Volatile matter	22 - 23
% Sulphur	0.3
FSI	6 - 7
Unit Processes (size range of feed mm)	
Heavy medium cyclones	38 x 0.6
Jig	0
Water only washing cyclones	0.6 x 0
Froth flotation	0.15 x 0
Fine cool dewatering	Rotary vacuum disc filter
Thermal dryer	Fluid bed 38 x 0
Fine rejects dewatering	Lagoon

Bullmoose Washplant Flowsheet
450 TPH Raw Coal



APPENDIX II

ANALYTICAL METHODS AND REPORTS

INORGANIC ANALYSIS OF SAMPLES FROM 1984 BRITISH COLUMBIA COAL PREPARATION PLANTS SURVEY.

Internal report
by
J. F. Dlouhy
May, 1985
Ottawa

Analytical Services Division
River Road Environmental Technology Centre
Department of the Environment

introduction

Samples for the analysis from the 1984 survey of two British Columbia coal preparation plants were received from the Pollution Measurement Division in 1984 and 1985. A similar analysis was performed in 1983. Due to different circumstances most of the work was done externaly. The coal samples were analyzed at the Department of energy, mines and resources (EMR), Energy Research Laboratories, Bells Corners Complex and at Bondar-Clegg & Co. (B-C), Ottawa. The filters were analyzed at Bondar-Clegg. On the request of the customer two filters and a blank were send for analysis to NEA Inc.,Beaverton, Oregon. Despite of repeated requests no results were received up to now. Probe washes were analyzed at Bondar-Clegg. Impinger contents were analyzed at Analytical Services Division (ASD). Request for the analysis by an external contractor was not accepted due to the too low chloride content. Samples were analyzed for different metals and nonmetals. On coals some other parameters were measured as well. Only the impinger contents were analyzed for chloride exclusively. The quality control was performed by the use of NBS standards and ASD standards. The ASD standards were either previously analyzed samples or samples prepared from standard solutions. The experimental work at ASD was done by Nicole Houle and Dr. Joseph F. Dlouhy.

Coal

Two composite samples were analyzed at the Department of energy, mines and resources (EMR) and at Bondar-Clegg (B-C). Results from both laboratories are in Table 1 which includes the ratios between B-C and EMR results as well. The ratios indicate the reliability of the results. It is an indirect measure of accuracy and precision. Four results in either one of the laboratories are dubious. The dubious results are one for Na, two for S and one for Si.

Two National Bureau of Standards coal samples were analyzed in both laboratories in order to ascertain the accuracy and precision. The results are in Table 2. There is one outlier present in the results for each laboratory. Two other coals from a previous survey which were already analyzed before at EMR, Atomic Energy of Canada and at Analytical Services Division were reanalyzed at EMR and newly analyzed at B-C. Table 3 contains the ratios between the old and new EMR results and the mean ratios. There are two outliers present for each sample. One for Na, two for P and one for Sr. Table 4 contains the ratios between B-C and EMR results for all six samples. There is a double outlier for P for Coal Valey samples. The presence of outliers is caused by errors in both laboratories. For the purpose of coal composition in Table 1 the Na error is assigned to B-C and the S errors are assigned to EMR results. The second S results line analyzed also at EMR by a wet method gives more satisfactory results and should be used. The EMR values are prefered in order to maintain

compatibility with S speciation results. The error assignment for Si can't be done. One laboratory is using the XRF method and has an error for S for the same method. The second laboratory is using a wet method, which for large quantities of Si easily causes a positive error, which is the case. There is the systematic bias for the moisture determination. The EMR results should be used. The ash EMR results from our past experience agreed to 0.06%. The EMR results should be therefore used. For C the EMR values should be used on account of very good agreement with the previous results. For all other results the mean value, where applicable, between B-C and EMR results should be used. Such values are presented in Table 5.

Filters

The quartz filter is superior to the glass fiber filter in composition for major elements Al, Ca, K, Mg and Na as can be seen in Table 6. The ratio for the blank element loading for these elements is better than 10:1 for the quartz filter. That causes higher precision and accuracy for the above named elements in quartz filter experiments.

The quartz filter was used only for filter sample #109. All other samples were collected on glass fiber filters. The net loadings in mg/filter are in Table 7. It contains all results including the negative values. These are caused by eventual contamination, lack of precision and accuracy, overall particulate loading and filter elemental composition. Table 8 contains the filter numbers with usable net filter loading values in the previous table. The criterion was >10% particulate element loading to filter element content. The inclusion of Al and Si results for samples with numbers higher than 400 is caused by about one order of magnitude larger particulate loadings than for other filters. Na loading for all filters was too low even for the quartz filter.

Probe washes

Probe washes were available as evaporated samples in 50 mL glass beakers. They were delivered to Bondar-Clegg and analyzed after digestion. From one sampling location the mean amount of probe washes was 69 mg. Two standards were prepared at ASD which contained seven major elements. The results are in Table 9. Both values for Na are obviously wrong. That was caused by the large amount of Na in the reagent blank. The difference between the given and the found values indicates 126.3% recovery for Na. The mean recovery for all seven elements is 106.0%. The results for all samples are in Table 10 and Table 11.

Impingers

The impinger content was supposed to be analyzed for the chloride at one contractor. That was rejected by the contractor after communication of ASD preliminary concentration results. All concentrations were below the detection limit for the methods used by the contractor. The analysis was then performed at ASD using the ion chromatography. The results are in Table 12. Different detection limits are caused by different volume of impinger content.

Table 1
Coal composition

Element or parameter	Bullmoose composite			Elkwood composite		
	EMR [%]	B-C [%]	Ratio [%]	EMR [%]	B-C [%]	Ratio [%]
Al	0.955	0.98	102.6	1.465	1.44	98.3
Ba	0.133			0.0164		
Ca	0.343	0.31	90.4	0.201	0.11	54.7
Fe	0.237	0.18	75.9	0.197	0.14	71.1
K	0.0593	0.05	84.3	0.0423	0.03	70.9
Mg	0.105	0.09	85.7	0.0522	0.04	76.6
Na	0.0607	0.06	98.8	0.0106	0.02	188.7
P	0.0334	0.04	119.8	0.0325	0.04	123.1
S	0.164	0.32	195.1	0.0906	0.26	287.0
Si	2.23	6.52	292.4	2.81	2.31	82.2
Sr	0.0124			0.00431		
Ti	0.113			0.106		
LOF	0.127			0.0805		
C	80.09	64.70	80.8	79.67	65.30	82.0
ash	8.61	8.05	93.5	10.19	9.88	97.0
moisture	0.60	0.36	60.0	0.42	0.28	66.7
volatile	25.77			21.18		
fixed carbon	65.02			68.21		
H	4.54			4.28		
S	0.38	0.32	84.2	0.30	0.26	86.7
N	1.24			1.30		
O (by difference)	4.54			3.84		
heat value [cal/g]	7798			7728		
S (sulphate)	0.00			0.00		
S (pyritic)	0.05			0.06		
S (organic)	0.33			0.24		

Notes: EMR Department of energy, mines and resources
B-C Bondar-Clegg Co. Ottawa
Ratio B-C/EMR
LOF loss on fusion
fixed carbon (by difference)

Table 2

NBS coal standards recovery

Laboratory	EMR	EMR	B-C	B-C			
Sample #	1632a	1635	1632a	1635	mean	s	n
	[%]	[%]	[%]	[%]	[%]	[%]	
Element							
Al	92.9	92.5	94.2	84.4	91.0	4.46	4
Ca	101.7		87.0		94.4		2
Fe	101.8	87.9	87.4	87.9	91.2	7.04	4
K	93.6		85.7		89.6		2
Mg	130.0		100.0		115.0		2
Na	132.1	91.7	119.0	(35.7)	114.3	20.61	3
S	(8.61)	73.0	88.6	69.7	77.1	10.10	3
Ti	87.2	103.5			95.4		2
mean	105.6	89.7	94.6	80.7			
s	18.13	11.00	11.90	9.66			
n	7	5	7	3			

Notes: EMR Department of energy, mines and resources
B-C Bondar-Clegg
() outliers not included in means etc.
s standard deviation
n number of elements

Table 3

Coal Valley coal samples 1982

1983/1985 EMR results ratios

Sample	#1	#2	mean
	[%]	[%]	[%]
Element			
Al	101.6	102.6	102.1
Ca	102.7	97.4	100.0
Fe	100.5	96.3	98.4
K	100.7	99.0	99.8
Mg	79.9	103.4	91.6
Na	92.4	(168.1)	92.4
P	(418.3)	(144.8)	
S	121.2	90.1	105.6
Si	101.1	104.1	102.6
Sr	(63.3)	83.8	83.8
Ti	107.3	105.6	106.4
mean	100.8	98.0	98.3
s	11.01	7.19	7.05
n	9	9	10

Notes: EMR Department of energy, mines and resources
s standard deviation
n number of elements
() outliers not included in means etc.

Table 4

Coal results

Bondar-Clegg/EMR results ratio

Sample	NBS 1632a	NBS 1635	Coal valley #1	Coal valley #2	Composite 1)	Composite 2)	mean	s	n
Element	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	
Al	101.4	91.2	100.0	93.3	102.6	98.3	97.9	4.47	6
Ca	85.5	98.4	99.1	89.5	90.4	(54.7)	92.6	5.93	5
Fe	85.8	101.0	87.3	83.1	75.9	71.1	84.0	10.35	6
K	91.6	78.1	82.2	68.5	84.3	70.9	79.3	8.64	6
Mg	76.9	116.3	100.5	82.7	85.7	76.6	89.8	15.65	6
Na	90.1	(40.9)	92.4	87.7	98.8	(188.7)	92.2	4.77	4
P	(1052.6)	(<917.4)	(859.6)	(240.0)	119.8	123.1	121.4		2
S	(1029.4)	94.3	113.2	143.6	(195.1)	(287.0)	117.0	24.87	3
Si	84.0	66.3	92.1	76.5	(292.4)	82.2	80.2	9.58	5
C	83.6	84.6	80.9	82.3	80.8	82.0	82.4	1.50	6
ash	97.8	78.4	102.6	93.4	93.5	97.0	93.8	8.26	6
moist	58.9	80.3	76.0	71.6	60.0	66.7	68.9	8.62	6
mean	85.6	88.9	93.3	88.4	89.2	85.3			
s	11.78	14.34	11.08	20.05	16.21	17.98			
n	10	10	11	11	10	9			

Notes: EMR Department of energy, mines and resources
s standard deviation
n number of elements
moist moisture
1) Bullmoose
2) Elkwood

Table 5

Composite coals

Best available parameters

Element or parameter	Bullmoose [%]	Elkwood [%]
Al	0.968	1.452
Ba	0.133	0.0164
Ca	0.326	0.156
Fe	0.208	0.168
K	0.0546	0.0362
Mg	0.0975	0.0461
Na	0.0604	0.0106
P	0.0367	0.0362
Si	?	2.56
Sr	0.0124	0.00431
Ti	0.113	0.106
LOF	0.127	0.0805
C	80.09	79.67
ash	8.61	10.19
moisture	0.60	0.42
volatile	25.77	21.18
fixed carbon	65.02	68.21
H	4.54	4.28
S	0.38	0.30
N	1.24	1.30
O (by difference)	4.54	3.84
heat value	7798 [cal/g] 32.65 [MJ/kg]	7728 [cal/g] 32.36 [MJ/kg]
S (sulphate)	0.00	0.00
S (pyritic)	0.05	0.06
S (organic)	0.33	0.24

Note:LOF loss on fusion

Table 6

Filter blanks

Element	#148 GFF	#500 GFF	#501 Quartz
	[mg/g]	[mg/g]	[mg/g]
Al	29.00	28.00	1.00
Ca	40.00	40.00	2.95
Fe	2.25	1.55	3.30
K	7.35	7.35	0.30
Mg	15.45	15.45	1.00
Na	107.00	107.00	6.40
P	0.07	0.06	0.54
S	2.88	3.28	8.16
Si	196.38	185.37	398.00

Note: GFF glass fiber filter

Table 7

Filters net loading
[mg/filter]

Sample / Element	#109	#120	#131	#142	#145	#409	#420	#431	#442
Al	1.25	-1.04	0.96	0.42	1.48	19.95	27.48	10.07	12.33
Ca	0.96	-0.66	-15.09	0.13	2.70	0.94	1.63	0.76	0.71
Fe	0.38	1.40	2.11	1.79	2.43	1.43	2.41	0.91	1.15
K	0.28	-2.22	-0.60	-0.38	-1.90	0.88	0.92	0.16	0.32
Mg	0.18	-1.21	0.39	0.09	-0.07	1.01	1.00	0.61	0.52
Na	0.30	2.50	-2.54	-1.90	-4.51	-3.11	-1.09	0.24	-1.84
P	0.49	0.41	1.23	0.65	0.54	0.16	0.26	0.08	0.15
S	-4.90	2.55	2.96	1.70	3.27	3.89	3.09	1.24	2.04
Si	-4.96	8.93	3.63	4.93	8.79	33.86	31.19	17.61	26.97

Table 8

Filters

Element	Usable information		
	Filter #		
Al	109		409-442
Ca	109		
Fe	109	120-145	409-442
K	109		
Mg	109		
Na			
P	109	120-145	409-442
S		120-145	409-442
Si			409-442

Table 9

Probe wash standards

Bondar-Clegg results

Sample	#504 given	#504 found	#504 recovery	#505 given	#505 found	#505 recovery	mean recovery
Element	[µg]	[µg]	[%]	[µg]	[µg]	[%]	[%]
Al	650	680	104.6	9000	9200	102.2	103.4
Ca	430	400	93.0	6500	6120	94.2	93.6
Fe	390	420	107.7	5500	6000	109.1	108.4
K	70	40	57.1	450	240	53.3	55.2
Mg	70	80	114.3	1000	1020	102.0	108.2
Na	70	(3360)	(4800)	450	(3840)	(853.3)	126.3 1)
P	-	4 2)	-	-	4 2)	-	-
S	-	219 2)	-	-	159 2)	-	-
Si	2000	2781	139.0	2000	3099	154.9	147.0
						mean	106.0
						s	28.4
						n	7

Notes: 1) calculated from the difference between given and found values
2) contamination?
() values in parenthesis are outliers
s standard deviation
n number of elements

Table 10

Probe washes

Bondar-Clegg results

Sample #	108	119	130	141	144	158
Element	[µg]	[µg]	[µg]	[µg]	[µg]	[µg]
Al	520	1020	780	860	760	760
Ca	540	400	620	640	360	460
Fe	800	680	380	320	520	380
K	60	120	100	100	80	80
Mg	140	160	160	140	140	140
Na	200	200	180	420	240	220
P	54	54	66	54	50	42
S	203	263	186	318	164	88
Si	3314	3174	2603	2290	2758	3043
Total solids	74500	72700	70300	59600	69900	66800
Found as oxides	15.0%	16.1%	13.8%	16.3%	14.0%	15.1%

Table 11

Probe washes

Bondar-Clegg results

Sample #	408 [µg]	419 [µg]	430 [µg]	441 [µg]	452 [µg]
Element					
Al	17300	18700	3940	10200	8520
Ca	3600	5420	1320	2960	2760
Fe	2280	3440	720	1480	1480
K	1700	2720	340	700	480
Mg	1120	1580	500	940	920
Na	440	500	220	380	320
P	75	80	80	184	88
S	3370	5417	1214	2882	2630
Si	38645	55359	13396	25146	21435
Total solids	1038300	1526800	367800	774500	593700
Found as oxides	13.2%	12.2%	11.9%	11.6%	13.0%

Table 12

Impinger content

ASD results [µg/impinger]

Sample #	Cl	Detection limit
1	<16	<16
110	201	<36
121	152	<36
132	72	<40
143	68	<38
146	93	<29
160	83	<46
410	98	<46
421	151	<47
432	67	<30
443	80	<36
454	83	<38

Note: ASD Analytical services division

ANALYTICAL PROTOCOLS FOR THE DETERMINATION OF PAH AND PCB IN STACK EMISSION SAMPLES

Analytical Services Division
Technical Services Branch
Environmental Protection Programs Directorate
River Road Environmental Technology Centre
Ottawa, Ontario.

December 1983

Stack emission samples consist of (a) solid samples such as filter and adsorbent (XAD-2), and (b) liquid samples such as water, ethylene glycol and solvent washes.

All liquid samples were split in half before sample extraction while solid samples were split only after soxhlet extraction.

1. CHEMICAL AND GLASSWARE PREPARATION

Before use, the XAD-2, Na_2SO_4, silica gel, glasswool, florisil and glassware had to be cleaned of contaminants.

The XAD-2 was first washed with deionized water then soxhlet extracted with a mixture of 50% acetone and hexane for 16 to 24 h. It was then oven dried at 100°C for 8 to 12 h.

The silica gel was cleaned in a large column by an elution of 500 mL methanol followed by 500 mL $MeCl_2$. It was oven dried at 160°C for 16 to 24 h.

The Na_2SO_4 and glasswool were also cleaned in a column by an elution of 500 mL $MeCl_2$ followed by 500 mL hexane. They were oven dried for 8 h at 260°C.

The florisil was soxhlet extracted for 24 h with 500 mL hexane. It was subsequently oven dried overnight and then muffled at 650°C for 7 h.

All the glassware was washed with the detergent "Swipe" and rinsed with deionized water followed by acetone and hexane. It was finally heat-treated for 8h at 350°C.

2. PCB

2.1 Sample Extraction

2.1.1 Filter and Adsorbent (XAD-2)

Each sample was transferred into a glass fiber thimble in a glass soxhlet apparatus. The sample was extracted with 250 mL benzene at a cycle rate of 5 to 8 cycle/h for a period of 16 to

24 h. The benzene extract was dried by passing through anhydrous sodium sulfate, and concentrated to 5 mL by rotary evaporation under reduced pressure at 30°C. One hundred millilitres of hexane was added to the benzene and concentrated to 5 mL.

2.1.2 Water

The sample was extracted three times by shaking vigorously with 100 mL of hexane in a separatory funnel. The combined extract was dried by passing through Na_2SO_4 and concentrated to 5 mL on a rotary evaporator.

2.1.3 Ethylene Glycol

The sample was mixed with half amount of deionized water and extracted three times by shaking in a separatory funnel with 100 mL of hexane each time. The extract was dried and concentrated as described above.

2.1.4 Solvent Wash

Each wash sample was dried by passing through Na_2SO_4 and evaporated to 5 mL by rotary evaporator.

2.2 Clean Up

A column (22 mm ID) loaded with 35 g of florisil and 2 g of Na_2SO_4 was prewashed with 100 mL of hexane. The concentrated extract was transferred to the florisil column and eluted with 250 mL of hexane at a rate of 2 to 4 mL/min. The hexane eluent was evaporated at 1 to 2 mL on a rotary evaporator and then was transferred in a calibrated centrifuge tube and evaporated further. Final volume was made up before GC injection (usually 0.5 mL).

2.3 Analysis

Every sample extract was spiked with both hexachlorobenzene (0.1 ug/mL) and P,P'-DDE(0.2 ug/mL) as internal standards for the calculation of relative retention time.

The external PCB standard mixture (Arochlor 1242 + Arochlor 1260) was injected into the GC between every fourth sample injection.

GC CONDITIONS

Instrument:	HP 5830A with EC detection
Column:	60 m x 0.25 mm durabound fused silica column
Oven Temperatures:	50°C hold 2 min., 20°C/min. to 150°C, 3°C/min.
to	to 300°C and hold 4 min.
Injection Mode:	Splitless for 1.5 min, inject at 0.3 min.

3. PAH

3.1 Sample Preparation

3.1.1 Filter and Adsorbent (XAD-2)

Each sample was soxhlet extracted with 250 mL of benzene for 24 h at a rate of 5 to 8 cycle/h for a period of 16 to 24 h. This was evaporated to 5 mL by rotary exaporation and subsequently solvent extracted.

3.1.2 Water

The sample was transferred into a separatory funnel and extracted 3 times with 100 mL portions of benzene by vigorous shaking. The benzene exract was evaporated to 5 mL by rotary evaporation and then solvent extracted.

3.1.3 Ethylene Glycol

Each sample was diluted with half amount of deionized water and transferred to a separatory funnel. The liquid was extracted 3 times with 100 mL portions of benzene by vigorous shaking. The benzene extract was evaporated to 5 mL by rotary evaporation and subsequently solvent extracted.

3.1.4 Solvent Wash

Each sample was evaporated to 5 mL by rotary evaporation. One hundred milliliters of benzene was added to the 5 mL residue and evaporated to 5 mL, and then solvent extracted.

3.2 Solvent Extraction

About 20 mL of cyclohexane was added to the 5 mL benzene extract. The extract was shaken with three 20 mL portions of dimethyl sulfoxide (DMSO) in a separatory funnel. After shaking

the DMSO and cyclohexane were allowed to separate and the DMSO layers were kept and combined for further extraction. One hundred and twenty milliliters of water were added to the combined DMSO layer to remove acids and bases.

The PAHs were back extracted into cyclohexane by shaking the water and DMSO mixture twice with 40 mL portions of cyclohexane. The cyclohexane extracts were combined and washed with 150 mL of water. The cyclohexane was then dried by elution through anhydrous sodium sulfate (Na_2SO_4) and evaporated by rotary evaporation to about 10 mL for column clean-up.

3.3 Clean-Up

An activated silica gel column, 20 cm x 1 cm ID, consisting of 25 g of silica gel and 1 g of Na_2SO_4 was washed with 150 mL of hexane. After the sample was tranferred to the column, it was eluted with 150 mL of hexane. The hexane eluent was discarded. PAHs were finally eluted with 150 mL of benzene. The benzene fraction was kept and evaporated to 1 to 2 mL by rotary evaporation.

Further concentration was performed with UHP nitrogen in a calibrated centrifuge tube at 20°C or air dried in a fumehood at 20°C. The volume was reduced to 0.5 mL for the analysis by gas chromatography.

3.4 Analysis

Every sample was made up to 0.5 mL and 1.0 uL was injected. Some of the samples were spiked with the mixture of PAH standard used for the analysis.

The PAH standard mixture was injected once a day before the samples.

GC CONDITIONS

Instrument:	Varian-Vista 6000 with FID detector
Column:	30 m DB-5, fused silica, dia. 0.25 mm
Oven Temperatures:	90°C hold 3 min., 5°C/min. to 280°C, hold 25 min.
Injection Mode:	on-column, pre-cooled, 90°C, 180°C/min. to 280°C, hold 60 min.

ANALYTICAL PROTOCOLS FOR THE DETERMINATION OF PCDD/PCDF IN STACK EMISSION SAMPLES

Analytical Services Division
Technical Services Branch
Environmental Protection Programs Directorate
River Road Environmental Technology Centre
Ottawa, Ontario.

December 1983

1. SAMPLE EXTRACTION

Stack emission samples consist of (a) solid samples such as filter and absorbent (XAD-2), and (b) liquid samples such as water, ethylene glycol and solvent washes.

1.1 Filter and Adsorbent (XAD-2)

Each solid sample was soxhlet extracted with 500 mL toluene at a cycle rate of 5 to 8 cycles/hr. for a period of 16 to 24 h. The toluene extract was dried by passing through anhydrous sodium sulfate, and concentrated to 1 mL by rotary evaporation under reduced pressure.

1.2 Water

Each aqueous sample was extracted three times with methylene chloride (100 mL, 2 x 50 mL) by shaking vigorously in a separatory funnel. The combined extract was dried by passing through Na_2SO_4 and reduced to 2 mL on a rotary evaporator.

1.3 Ethylene Glycol

The sample was mixed with an equal amount of deionized water and extracted three times with hexane (100 mL, 2 x 50 mL) by shaking vigorously in a separatory funnel. The combined extract was dried and concentrated as described above.

1.4 Solvent Wash

Each wash sample was dried by passing through Na_2SO_4 and evaporated to 2 mL by rotary evaporation.

2. CLEAN-UP

All extracts were chromatographed on a series of three columns. The first column contained 3 g of silica, 2 g of 33% 1M sodium hydroxide on silica and 4 g of 44% sulfuric acid on silica. The second one contained 1.5 g of 10% silver nitrate on silica, and the third column was packed with 2.5 g of freshly activated basic alumina. Most of the interfering compounds such as PCBs, chlorinated benzenes and sulfides were removed through these columns.

The concentrated sample after clean-up was transferred into a 0.5 mL amber vial and purged to dryness under a slow stream of nitrogen. Final volume was made up before GC injection (usually 0.1 mL).

3. ANALYSIS

PCDD and PCDF were identified and quantified by GC and GC/MS.

GC CONDITIONS

Instrument:	HP 5830A with EC detection
Column:	60 m x 0.25 mm durabound fused silica column
Oven Temperatures:	70° hold 3 min., 20°C/min. to 210°C, 3°C/min. to 300°C and hold 15 min.
Injection Mode:	Autoinjection, splitless for 1.5 min.

GC/MS CONDITIONS

Instrument:	Finnigan 4500
Column:	60 m x 0.25 mm durabond fused silica column
Oven:	120°C hold 1 min., 15°C/min to 200°C, 2.5°C/min to 280°C and hold 30 min.
Injection:	On column injection

MS - Carrier gas He for EI
- Ion source temperature 215°C
- Multiple ion detection for individual isomers

APPENDIX III

STACK TRAVERSE DATA

RUN NO. 1

BULLMOOSE COAL PREP.PLANT, TUMBLER RIDGE

AUG.29/84 12:56-17:47 PART.#1

TRAVERSE DATA

TRAVERSE PT.	SAMPLE TIME (MIN)	STACK GAS TEMP (DEG. F)	VELOCITY PRESSURE (IN. H2O)	ORIFICE PRESSURE (IN. H2O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEG. F) IN	GAS METER TEMP (DEG. F) OUT
					334.72		
1	5.0	115	0.630	2.000	338.39	89	79
2	5.0	111	0.730	2.300	342.28	97	80
3	5.0	114	0.560	1.800	346.10	104	82
4	5.0	110	0.680	2.200	350.30	108	84
5	5.0	114	0.580	1.870	354.49	113	86
6	5.0	114	0.580	1.870	358.39	116	87
7	5.0	114	0.580	1.870	362.29	116	88
8	5.0	114	0.500	1.620	365.93	117	89
9	5.0	114	0.430	1.400	369.34	118	91
10	5.0	107	0.680	2.200	373.62	121	93
11	5.0	113	0.470	1.540	377.26	124	95
12	5.0	112	0.380	1.250	380.52	124	98
13	5.0	113	0.400	1.320	383.82	124	99
14	5.0	113	0.350	1.160	387.06	125	100
15	5.0	113	0.100	0.330	388.66	121	101
16	5.0	101	0.330	1.120	391.36	121	101
17	5.0	110	0.150	0.470	393.58	121	102
18	5.0	108	0.410	1.370	396.86	125	102
19	5.0	106	0.450	1.510	400.47	129	103
20	5.0	108	0.480	1.610	404.19	132	104
21	5.0	105	0.480	1.620	407.93	133	104
22	5.0	104	0.530	1.800	411.90	135	106
23	5.0	109	0.460	1.550	415.57	138	106
24	5.0	98	0.550	1.890	419.47	137	107
21	5.0	105	0.560	1.950	423.51	100	96
21	5.0	108	0.300	1.000	426.53	106	98
21	5.0	103	0.310	1.040	429.57	113	99
21	5.0	106	0.330	1.100	432.67	118	98
20	5.0	112	0.310	1.020	435.65	120	99
19	5.0	112	0.270	0.890	438.51	122	100
18	5.0	111	0.250	0.830	441.20	123	101
17	5.0	111	0.260	0.870	443.90	123	102
16	5.0	110	0.270	0.900	446.72	124	102
15	5.0	113	0.300	1.000	449.64	125	103
14	5.0	101	0.410	1.390	452.96	126	103
13	5.0	109	0.400	1.340	456.54	129	104
12	5.0	108	0.600	2.020	460.46	131	105
11	5.0	109	0.560	1.880	464.30	132	106
10	5.0	110	0.580	1.950	468.40	133	107
9	5.0	105	0.660	2.240	472.79	134	107
8	5.0	105	0.590	2.010	477.05	136	108
7	5.0	102	0.750	2.570	481.64	136	109
6	5.0	107	0.610	2.070	485.87	138	109
5	5.0	105	0.820	2.800	490.64	139	110
4	5.0	109	0.750	2.540	495.29	141	110
3	5.0	104	0.980	3.350	500.47	141	111
2	5.0	109	0.850	2.890	505.47	143	112
1	5.0	109	0.840	2.860	510.37	143	112
AVERAGE		109		1.667		124	100

AVE. TEMPERATURE = 42.6 DEG. C

TOTAL SAMPLE TIME = 240.0 MIN.

TOTAL SAMPLE VOLUME = 142.542 SCF OR 4.037 SCM

SAMPLING DATA

BAROMETRIC PRESSURE (IN.HG.)	26.45	OR	671.83	MM HG
PITOT TUBE FACTOR	0.734			
METER CALIBRATION FACTOR	0.973			
NOZZLE DIAMETER (IN.)	0.250	OR	6.350	MM
WT. OF PART. IN PROBE WASH (GM)	0.07450			
WT. OF PART. ON FILTER (GM)	0.11200			
WATER COLLECTED IN IMPINGERS (ML)	312.2			

ANALYSIS OF ISOKINETICITY

TRAVERSE PT.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
1	5.0	0.0140	0.0149	93.6
2	5.0	0.0146	0.0160	91.5
3	5.0	0.0143	0.0141	101.7
4	5.0	0.0155	0.0154	100.7
5	5.0	0.0155	0.0143	108.4
6	5.0	0.0144	0.0143	100.5
7	5.0	0.0143	0.0143	100.3
8	5.0	0.0134	0.0133	100.9
9	5.0	0.0125	0.0123	101.4
10	5.0	0.0155	0.0154	100.4
11	5.0	0.0132	0.0129	102.6
12	5.0	0.0118	0.0116	101.8
13	5.0	0.0119	0.0119	100.4
14	5.0	0.0117	0.0111	105.2
15	5.0	0.0057	0.0059	96.9
16	5.0	0.0095	0.0107	89.4
17	5.0	0.0080	0.0072	110.0
18	5.0	0.0117	0.0120	97.7
19	5.0	0.0128	0.0125	102.2
20	5.0	0.0132	0.0129	101.7
21	5.0	0.0132	0.0129	102.2
22	5.0	0.0139	0.0136	102.4
23	5.0	0.0129	0.0127	101.9
24	5.0	0.0135	0.0137	98.4
21	5.0	0.0147	0.0139	105.6
21	5.0	0.0110	0.0102	107.3
21	5.0	0.0109	0.0104	105.1
21	5.0	0.0111	0.0107	103.8
20	5.0	0.0108	0.0104	103.2
19	5.0	0.0103	0.0097	105.8
18	5.0	0.0097	0.0094	103.1
17	5.0	0.0097	0.0096	101.3
16	5.0	0.0101	0.0097	103.8
15	5.0	0.0105	0.0103	102.2
14	5.0	0.0117	0.0119	98.0
13	5.0	0.0127	0.0118	107.7
12	5.0	0.0139	0.0145	96.2
11	5.0	0.0136	0.0140	97.1
10	5.0	0.0145	0.0143	101.9
9	5.0	0.0154	0.0151	101.9
8	5.0	0.0149	0.0143	104.3
7	5.0	0.0160	0.0161	99.3
6	5.0	0.0148	0.0146	101.6
5	5.0	0.0167	0.0169	98.9
4	5.0	0.0163	0.0162	100.9
3	5.0	0.0180	0.0184	97.9
2	5.0	0.0175	0.0172	101.7
1	5.0	0.0171	0.0171	100.0

AVERAGE PERCENT ISOKINETICITY ACHIEVED 101.1

FLOW CONDITIONS DURING TEST

STACK AREA FT2	69.64	OR	6.47	SQR M
ABS. STACK PRESS.(IN. HG.)	26.42	OR	671.12	MM HG
STACK GAS DRY MOL. WT.	29.13			
AVG. STACK GAS VELOCITY(FPS)	37.98	OR	11.58	M/S
GAS FLOW(ACFM-DRY)	143597	OR	4067	ACM/M
GAS FLOW(SCFM-DRY)	119763	OR	3392	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O2	18.37	16.62
CO2	2.47	2.24
CO	0.00	0.00
N2	79.16	71.63
H2O		9.51

SPECIFIC GRAVITY OF FLUE GAS(AIR=1.0) 0.97

PARTICULATE EMISSION RATE

LBS/SCF	2.885E-06	OR	4.621E-02	GM/SCM
LBS/ACF	2.177E-06	OR	3.487E-02	GM/ACM
GRAINS/SCF	2.020E-02			
GRAINS/SCF (12% CO2)	9.811E-02			
EXCESS AIR (PERCENT)	683.77			
GRAINS/SCF AT 50% EA	1.067E-01			
GRAINS/ACF	1.524E-02			
LBS/HR	2.073E+01	OR	9.404E+00	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY

BULLMOOSE COAL PREP. PLANT, TUMBLER RIDGE

AUG.31/84 9:44-14:07 PART.#3A

TRAVERSE DATA

TRAVERSE PT.	SAMPLE TIME (MIN)	STACK GAS TEMP (DEG. F)	VELOCITY PRESSURE (IN. H2O)	ORIFICE PRESSURE (IN. H2O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEG. F) IN	OUT
					710.72		
1	5.0	103	0.550	1.760	714.36	86	81
2	5.0	103	0.670	2.150	718.53	92	82
3	5.0	99	0.770	2.490	723.05	101	84
4	5.0	109	0.480	1.530	726.68	106	85
5	5.0	100	0.750	2.430	731.07	110	86
6	5.0	102	0.630	2.040	735.13	111	88
7	5.0	103	0.500	1.630	738.80	110	90
8	5.0	102	0.630	2.060	742.90	118	92
9	5.0	104	0.450	1.470	746.34	120	93
10	5.0	107	0.520	1.690	750.09	119	95
11	5.0	108	0.470	1.530	753.68	120	97
12	5.0	102	0.500	1.650	757.35	121	97
13	5.0	99	0.440	1.460	760.84	122	99
14	5.0	105	0.150	0.490	763.06	120	99
15	5.0	100	0.370	1.230	766.05	117	100
16	5.0	104	0.430	1.420	769.44	121	100
17	5.0	98	0.470	1.570	773.14	124	101
18	5.0	102	0.440	1.460	776.60	126	100
19	5.0	96	0.460	1.550	780.18	125	102
20	5.0	102	0.490	1.630	783.91	126	102
21	5.0	103	0.490	1.630	787.62	127	102
22	5.0	108	0.490	1.620	791.32	128	103
22	5.0	103	0.510	1.700	795.09	128	103
22	5.0	106	0.500	1.660	798.84	128	104
21	5.0	105	0.360	1.190	802.06	102	99
21	5.0	104	0.360	1.190	805.20	110	100
21	5.0	106	0.360	1.190	808.35	115	100
21	5.0	104	0.370	1.220	811.57	118	100
20	5.0	109	0.370	1.210	814.80	120	100
19	5.0	111	0.350	1.140	817.95	121	101
18	5.0	108	0.370	1.220	821.16	122	101
17	5.0	107	0.430	1.420	824.63	124	102
16	5.0	108	0.470	1.550	828.25	125	102
15	5.0	108	0.520	1.720	832.07	127	103
14	5.0	103	0.580	1.930	836.08	128	103
13	5.0	101	0.610	2.040	840.20	130	104
12	5.0	101	0.650	2.180	844.44	131	105
11	5.0	103	0.600	2.000	848.54	131	106
10	5.0	108	0.500	1.690	852.34	130	105
9	5.0	109	0.400	1.320	855.77	129	106
8	5.0	106	0.380	1.260	859.08	127	106
7	5.0	105	0.430	1.430	862.54	127	106
6	5.0	104	0.540	1.800	866.39	128	106
5	5.0	107	0.360	1.200	869.65	128	106
4	5.0	102	0.700	2.350	873.96	129	106
3	5.0	103	0.720	2.410	878.57	132	106
2	5.0	105	0.710	2.370	882.93	134	107
1	5.0	104	0.640	2.140	887.18	134	107
AVERAGE		104		1.643		121	99

AVG. TEMPERATURE = 40.0 DEG. C

TOTAL SAMPLE TIME = 240.0 MIN.

TOTAL SAMPLE VOLUME = 142.808 SCF OR 4.044 SCM

SAMPLING DATA

BAROMETRIC PRESSURE	(IN.HG.)	26.29	OR	667.77	MM HG
PITOT TUBE FACTOR		0.734			
METER CALIBRATION FACTOR		0.973			
NOZZLE DIAMETER	(IN.)	0.250	OR	6.350	MM
WT. OF PART. IN PROBE WASH	(GM)	0.07030			
WT. OF PART. ON FILTER	(GM)	0.10710			
WATER COLLECTED IN IMPINGERS	(ML)	276.2			

ANALYSIS OF ISOKINETICITY

TRAVERSE PT.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
1	5.0	0.0135	0.0138	97.3
2	5.0	0.0153	0.0153	100.4
3	5.0	0.0163	0.0163	100.2
4	5.0	0.0132	0.0130	102.0
5	5.0	0.0157	0.0161	97.7
6	5.0	0.0146	0.0148	98.4
7	5.0	0.0131	0.0132	99.7
8	5.0	0.0146	0.0148	98.4
9	5.0	0.0122	0.0125	97.4
10	5.0	0.0134	0.0135	99.1
11	5.0	0.0126	0.0128	99.5
12	5.0	0.0129	0.0132	98.1
13	5.0	0.0122	0.0123	98.8
14	5.0	0.0078	0.0072	108.2
15	5.0	0.0105	0.0113	92.7
16	5.0	0.0119	0.0122	97.5
17	5.0	0.0129	0.0127	101.0
18	5.0	0.0121	0.0124	97.8
19	5.0	0.0124	0.0126	98.4
20	5.0	0.0130	0.0130	99.8
21	5.0	0.0130	0.0131	99.3
22	5.0	0.0130	0.0131	99.3
22	5.0	0.0131	0.0133	98.7
22	5.0	0.0131	0.0132	99.3
21	5.0	0.0116	0.0112	103.1
21	5.0	0.0112	0.0112	99.6
21	5.0	0.0112	0.0112	99.7
21	5.0	0.0114	0.0114	100.1
20	5.0	0.0115	0.0114	100.7
19	5.0	0.0112	0.0111	100.9
18	5.0	0.0114	0.0114	99.7
17	5.0	0.0122	0.0123	99.7
16	5.0	0.0128	0.0128	99.5
15	5.0	0.0135	0.0135	99.6
14	5.0	0.0140	0.0142	98.5
13	5.0	0.0143	0.0145	98.3
12	5.0	0.0147	0.0150	97.9
11	5.0	0.0142	0.0144	98.6
10	5.0	0.0133	0.0132	100.6
9	5.0	0.0120	0.0119	101.5
8	5.0	0.0116	0.0115	100.4
7	5.0	0.0121	0.0122	98.6
6	5.0	0.0134	0.0137	97.8
5	5.0	0.0114	0.0112	101.6
4	5.0	0.0150	0.0156	96.1
3	5.0	0.0160	0.0158	101.2
2	5.0	0.0152	0.0157	96.3
1	5.0	0.0147	0.0149	98.7

AVERAGE PERCENT ISOKINETICITY ACHIEVED 99.1

FLOW CONDITIONS DURING TEST

STACK AREA FT2	69.64	OR	6.47	SQR M
ABS. STACK PRESS.(IN. HG.)	26.27	OR	667.13	MM HG
STACK GAS DRY MOL. WT.	29.04			
AVG. STACK GAS VELOCITY(FPS)	38.26	OR	11.66	M/S
GAS FLOW(ACFM-DRY)	146310	OR	4144	ACM/M
GAS FLOW(SCFM-DRY)	122303	OR	3464	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O2	18.90	17.29
CO2	1.77	1.62
CO	0.00	0.00
N2	79.33	72.59
H2O		8.49

SPECIFIC GRAVITY OF FLUE GAS(AIR=1.0) 0.97

PARTICULATE EMISSION RATE

LBS/SCF	2.739E-06	OR	4.387E-02	GM/SCM
LBS/ACF	2.095E-06	OR	3.356E-02	GM/ACM
GRAINS/SCF	1.917E-02			
GRAINS/SCF (12% CO2)	1.300E-01			
EXCESS AIR (PERCENT)	858.40			
GRAINS/SCF AT 50% EA	1.258E-01			
GRAINS/ACF	1.467E-02			
LBS/HR	2.010E+01	OR	9.117E+00	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY

BULLMOOSE COAL PREP. PLANT, TUMBLER RIDGE

AUG.31/84 16:32-19:28 PART#3B

TRAVERSE DATA

TRAVERSE PT.	SAMPLE TIME (MIN.)	STACK GAS TEMP (DEG. F.)	VELOCITY PRESSURE (IN. H2O)	ORIFICE PRESSURE (IN. H2O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEG. F) IN	GAS METER TEMP (DEG. F) OUT
					887.41		
21	3.0	91	0.500	1.670	889.59	86	85
21	3.0	95	0.490	1.630	891.77	89	85
21	3.0	96	0.500	1.670	893.95	95	86
21	3.0	98	0.490	1.620	896.13	98	86
20	3.0	101	0.440	1.450	898.22	103	87
19	3.0	102	0.400	1.320	900.20	94	87
18	3.0	97	0.450	1.500	902.32	98	88
17	3.0	102	0.430	1.420	904.37	103	89
16	3.0	100	0.520	1.730	906.60	107	90
15	3.0	101	0.480	1.600	908.78	112	91
14	3.0	108	0.480	1.580	910.95	114	92
13	3.0	102	0.560	1.860	913.26	117	92
12	3.0	98	0.640	2.150	915.77	119	93
11	3.0	109	0.470	1.550	917.97	121	94
10	3.0	109	0.430	1.420	920.05	122	95
9	3.0	105	0.460	1.540	922.20	122	96
8	3.0	102	0.530	1.780	924.48	123	96
7	3.0	113	0.160	0.530	925.88	122	97
6	3.0	94	0.680	2.360	928.43	125	98
5	3.0	91	0.350	1.200	930.46	126	100
4	3.0	109	0.300	1.000	932.30	125	99
3	3.0	99	0.270	0.920	934.06	124	100
2	3.0	98	0.680	2.320	936.61	125	101
1	3.0	95	0.680	2.330	939.26	129	101
24	3.0	88	0.380	1.310	941.24	104	98
21	3.0	104	0.320	1.080	943.12	107	100
21	3.0	91	0.360	1.240	945.06	110	99
21	3.0	95	0.380	1.300	947.04	114	99
20	3.0	107	0.370	1.240	949.00	117	99
19	3.0	111	0.400	1.330	951.01	119	100
18	3.0	110	0.360	1.200	952.97	121	100
17	3.0	99	0.440	1.490	955.07	122	100
16	3.0	105	0.430	1.450	957.18	124	101
15	3.0	99	0.530	1.800	959.49	126	101
14	3.0	108	0.480	1.610	961.72	127	102
13	3.0	91	0.630	2.170	964.22	128	101
13	3.0	99	0.600	2.040	966.71	131	102
11	3.0	99	0.640	2.180	969.26	132	102
10	3.0	98	0.630	2.150	971.79	133	103
9	3.0	96	0.530	1.820	974.19	133	104
8	3.0	97	0.540	1.850	976.56	133	104
7	3.0	97	0.550	1.890	978.99	133	105
6	3.0	97	0.580	1.990	981.45	134	104
5	3.0	95	0.610	1.070	983.41	132	105
4	3.0	95	0.670	2.310	985.52	131	105
3	3.0	94	0.620	2.140	986.51	134	105
2	3.0	96	0.440	1.510	990.74	134	106
1	3.0	100	0.420	1.440	992.91	133	106
AVERAGE		100		1.617		119	97

AVE. TEMPERATURE = 37.5 DEG. C

TOTAL SAMPLE TIME = 144.0 MIN.

TOTAL SAMPLE VOLUME = 85.569 SCF OR 2.423 SCM

SAMPLING DATA

BAROMETRIC PRESSURE (IN.HG.)	26.26	OR	667.00	MM HG
PITOT TUBE FACTOR	0.734			
METER CALIBRATION FACTOR	0.973			
NOZZLE DIAMETER (IN.)	0.250	OR	6.350	MM
WT. OF PART. IN PROBE WASH (GM)	0.06990			
WT. OF PART. ON FILTER (GM)	0.08130			
WATER COLLECTED IN IMPINGERS (ML)	145.6			

ANALYSIS OF ISOKINETICITY

TRAVERSE PT.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
21	3.0	0.0129	0.0130	99.3
21	3.0	0.0130	0.0129	100.5
21	3.0	0.0129	0.0131	99.0
21	3.0	0.0130	0.0130	99.9
20	3.0	0.0124	0.0123	100.7
19	3.0	0.0119	0.0118	100.9
18	3.0	0.0126	0.0124	101.0
17	3.0	0.0122	0.0122	99.8
16	3.0	0.0132	0.0134	98.2
15	3.0	0.0128	0.0129	99.4
14	3.0	0.0129	0.0130	99.3
13	3.0	0.0135	0.0139	97.2
12	3.0	0.0146	0.0148	98.3
11	3.0	0.0130	0.0128	101.0
10	3.0	0.0122	0.0123	99.7
9	3.0	0.0126	0.0127	99.2
8	3.0	0.0132	0.0135	97.7
7	3.0	0.0063	0.0075	105.9
6	3.0	0.0146	0.0152	95.6
5	3.0	0.0115	0.0109	105.2
4	3.0	0.0107	0.0103	104.8
3	3.0	0.0101	0.0096	104.7
2	3.0	0.0146	0.0153	95.7
1	3.0	0.0151	0.0152	98.8
21	3.0	0.0114	0.0113	100.3
21	3.0	0.0110	0.0105	104.6
21	3.0	0.0111	0.0111	100.6
21	3.0	0.0114	0.0114	100.0
20	3.0	0.0115	0.0114	101.1
19	3.0	0.0118	0.0119	99.6
18	3.0	0.0115	0.0112	102.3
17	3.0	0.0121	0.0123	98.2
16	3.0	0.0122	0.0122	100.1
15	3.0	0.0132	0.0135	98.1
14	3.0	0.0130	0.0130	100.0
13	3.0	0.0141	0.0146	96.6
13	3.0	0.0142	0.0144	98.5
11	3.0	0.0145	0.0148	98.0
10	3.0	0.0144	0.0147	97.6
9	3.0	0.0136	0.0135	100.7
8	3.0	0.0134	0.0136	98.6
7	3.0	0.0138	0.0137	100.1
6	3.0	0.0139	0.0141	98.6
5	3.0	0.0110	0.0144	76.5
4	3.0	0.0142	0.0151	93.8
3	3.0	0.0146	0.0145	100.2
2	3.0	0.0126	0.0123	102.6
1	3.0	0.0125	0.0120	102.4

AVERAGE PERCENT ISOKINETICITY ACHIEVED 99.3

FLOW CONDITIONS DURING TEST

STACK AREA FT2	69.64	OR	6.47	SQR M
ABS. STACK PRESS.(IN. HG.)	26.23	OR	666.26	MM HG
STACK GAS DRY MOL. WT.	29.05			
AVG. STACK GAS VELOCITY(FPS)	37.56	OR	11.45	M/S
GAS FLOW(ACFM-DRY)	145101	OR	4109	ACM/M
GAS FLOW(SCFM-DRY)	122083	OR	3457	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O2	19.10	17.66
CO2	1.80	1.66
CO	0.00	0.00
N2	79.10	73.13
H2O		7.55

SPECIFIC GRAVITY OF FLUE GAS(AIR=1.0) 0.97

PARTICULATE EMISSION RATE

LBS/SCF	3.696E-06	OR	6.240E-02	GM/SCM
LBS/ACF	3.031E-06	OR	4.854E-02	GM/ACM
GRAINS/SCF	2.727E-02			
GRAINS/SCF (12% CO2)	1.818E-01			
EXCESS AIR (PERCENT)	984.23			
GRAINS/SCF AT 50% EA	1.995E-01			
GRAINS/ACF	2.121E-02			
LBS/HR	2.854E+01	OR	1.295E+01	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY

BULLMOOSE COAL PREP. PLANT, TUMBLER RIDGE

SEPT.1/84 10:09-14:30 PART.#4

TRAVERSE DATA

TRAVERSE PT.	SAMPLE TIME (MIN)	STACK GAS TEMP (DEG. F)	VELOCITY PRESSURE (IN. H2O)	ORIFICE PRESSURE (IN. H2O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEG. F) IN	OUT
					993.83		
1	5.0	111	0.460	1.260	997.20	81	76
2	5.0	102	0.540	1.740	1000.50	84	79
3	5.0	90	0.530	1.740	1004.19	87	79
4	5.0	100	0.500	1.600	1007.75	97	80
5	5.0	105	0.460	1.460	1011.17	102	81
6	5.0	108	0.440	1.410	1014.50	105	83
7	5.0	104	0.450	1.460	1017.90	107	85
8	5.0	99	0.530	1.730	1021.63	109	86
9	5.0	100	0.530	1.730	1025.37	111	87
10	5.0	88	0.620	2.080	1029.44	112	88
11	5.0	108	0.630	2.050	1033.47	114	90
12	5.0	93	0.710	2.370	1037.66	116	91
13	5.0	106	0.620	2.030	1041.64	116	92
14	5.0	110	0.520	1.690	1045.38	117	93
15	5.0	108	0.500	1.640	1049.03	116	94
16	5.0	104	0.480	1.580	1052.66	116	94
17	5.0	108	0.470	1.540	1056.28	114	95
18	5.0	107	0.480	1.580	1059.92	117	96
19	5.0	106	0.460	1.510	1063.46	116	95
20	5.0	109	0.440	1.440	1066.89	116	96
21	5.0	105	0.480	1.590	1070.45	116	96
22	5.0	106	0.470	1.550	1074.02	118	96
23	5.0	108	0.480	1.580	1077.58	117	97
24	5.0	109	0.480	1.580	1081.19	117	96
1	5.0	100	0.500	1.650	1084.65	92	90
2	5.0	99	0.510	1.690	1088.43	101	91
3	5.0	107	0.460	1.500	1092.02	109	91
4	5.0	111	0.440	1.430	1095.50	113	92
5	5.0	101	0.460	1.520	1099.09	115	93
6	5.0	96	0.530	1.770	1102.79	117	93
7	5.0	101	0.490	1.650	1106.49	119	94
8	5.0	105	0.480	1.580	1110.20	120	94
9	5.0	93	0.550	1.850	1113.99	118	94
10	5.0	102	0.570	1.890	1117.81	118	95
11	5.0	102	0.610	2.020	1122.06	120	95
12	5.0	96	0.710	2.380	1126.42	122	96
13	5.0	96	0.650	2.180	1130.70	124	96
14	5.0	104	0.330	1.090	1133.93	124	97
15	5.0	98	0.750	2.510	1138.25	122	97
16	5.0	106	0.250	0.830	1141.25	122	97
17	5.0	106	0.370	1.220	1144.38	120	98
18	5.0	108	0.340	1.120	1147.51	120	96
19	5.0	111	0.190	0.620	1150.00	118	97
20	5.0	103	0.620	2.060	1153.97	117	98
21	5.0	111	0.230	0.750	1156.80	118	98
22	5.0	107	0.430	1.420	1160.19	118	97
23	5.0	103	0.650	2.160	1164.29	116	97
24	5.0	105	0.500	1.650	1168.11	120	97
AVERAGE		103		1.632		113	92

AVE. TEMPERATURE = 39.6 DEG. C

TOTAL SAMPLE TIME = 240.0 MIN.

TOTAL SAMPLE VOLUME = 143.031 SCF OR 4.051 SCM

SAMPLING DATA

BAROMETRIC PRESSURE (IN.HG.)	26.31	OR	668.27	MM HG
PITOT TUBE FACTOR	0.734			
METER CALIBRATION FACTOR	0.973			
NOZZLE DIAMETER (IN.)	0.250	OR	6.350	MM
WT. OF PART. IN PROBE WASH (GM)	0.05960			
WT. OF PART. ON FILTER (GM)	0.13030			
WATER COLLECTED IN IMPINGERS (ML)	265.4			

ANALYSIS OF ISOKINETICITY

TRAVERSE PT.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
1	5.0	0.0127	0.0119	106.7
2	5.0	0.0122	0.0137	89.0
3	5.0	0.0133	0.0134	99.1
4	5.0	0.0131	0.0132	98.6
5	5.0	0.0124	0.0127	98.3
6	5.0	0.0121	0.0124	97.7
7	5.0	0.0122	0.0125	97.9
8	5.0	0.0133	0.0135	98.3
9	5.0	0.0133	0.0135	98.4
10	5.0	0.0142	0.0145	97.9
11	5.0	0.0145	0.0149	97.5
12	5.0	0.0146	0.0156	94.1
13	5.0	0.0142	0.0147	96.6
14	5.0	0.0134	0.0135	99.2
15	5.0	0.0130	0.0132	98.5
16	5.0	0.0129	0.0129	99.6
17	5.0	0.0129	0.0128	100.8
18	5.0	0.0129	0.0130	99.9
19	5.0	0.0126	0.0127	99.3
20	5.0	0.0122	0.0124	98.6
21	5.0	0.0126	0.0129	97.6
22	5.0	0.0127	0.0128	98.8
23	5.0	0.0127	0.0130	97.7
24	5.0	0.0129	0.0130	99.3
1	5.0	0.0125	0.0131	95.1
2	5.0	0.0135	0.0133	101.9
3	5.0	0.0129	0.0127	101.8
4	5.0	0.0125	0.0124	100.8
5	5.0	0.0127	0.0126	100.6
6	5.0	0.0129	0.0135	96.0
7	5.0	0.0130	0.0130	100.0
8	5.0	0.0131	0.0129	101.6
9	5.0	0.0132	0.0137	96.1
10	5.0	0.0135	0.0141	95.9
11	5.0	0.0150	0.0145	103.0
12	5.0	0.0152	0.0156	97.2
13	5.0	0.0149	0.0149	99.5
14	5.0	0.0113	0.0107	105.7
15	5.0	0.0151	0.0161	93.9
16	5.0	0.0106	0.0093	113.2
17	5.0	0.0110	0.0114	97.2
18	5.0	0.0111	0.0109	101.6
19	5.0	0.0089	0.0082	108.5
20	5.0	0.0140	0.0147	95.5
21	5.0	0.0101	0.0090	112.1
22	5.0	0.0120	0.0123	98.1
23	5.0	0.0145	0.0150	96.5
24	5.0	0.0135	0.0132	102.2

AVERAGE PERCENT ISOKINETICITY ACHIEVED 99.2

FLOW CONDITIONS DURING TEST

STACK AREA FT2	69.64	OR	6.47	SQR M
ABS. STACK PRESS.(IN. HG.)	26.28	OR	667.41	MM HG
STACK GAS DRY MOL. WT.	29.04			
AVG. STACK GAS VELOCITY(FPS)	38.16	OR	11.63	M/S
GAS FLOW(ACFM-DRY)	146424	OR	4147	ACM/M
GAS FLOW(SCFM-DRY)	122576	OR	3471	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O2	19.05	17.52
CO2	1.74	1.60
CO	0.00	0.00
N2	79.18	72.70
H2O		8.18

SPECIFIC GRAVITY OF FLUE GAS(AIR=1.0) 0.97

PARTICULATE EMISSION RATE

LBS/SCF	2.928E-06	OR	4.689E-02	GM/SCM
LBS/ACF	2.250E-06	OR	3.604E-02	GM/ACM
GRAINS/SCF	2.049E-02			
GRAINS/SCF (12% CO2)	1.413E-01			
EXCESS AIR (PERCENT)	962.72			
GRAINS/SCF AT 50% EA	1.478E-01			
GRAINS/ACF	1.575E-02			
LBS/HR	2.153E+01	OR	9.766E+00	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY

BULLMOOSE COAL PREP. PLANT, TUMBLER RIDGE

SEPT.2/84 10:06-14:36 PART.#5

TRAVERSE DATA

TRAVERSE PT.	SAMPLE TIME (MIN)	STACK GAS TEMP (DEG. F.)	VELOCITY PRESSURE (IN. H2O)	ORIFICE PRESSURE (IN. H2O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEG. F.) IN	OUT
					168.34		
21	5.0	111	0.370	1.170	171.37	77	76
21	5.0	92	0.530	1.730	174.96	82	76
21	5.0	111	0.430	1.360	178.29	91	77
21	5.0	102	0.430	1.380	181.58	94	78
20	5.0	112	0.380	1.200	184.72	100	79
19	5.0	107	0.360	1.220	187.84	102	81
18	5.0	106	0.440	1.410	191.17	104	82
17	5.0	101	0.450	1.470	194.57	106	83
16	5.0	108	0.440	1.420	197.97	109	85
15	5.0	98	0.570	1.880	201.79	111	87
14	5.0	102	0.620	2.030	205.79	113	89
13	5.0	106	0.640	2.080	209.85	116	90
12	5.0	101	0.620	2.700	214.45	118	91
11	5.0	106	0.780	2.550	218.96	120	92
10	5.0	107	0.430	1.410	222.43	122	94
9	5.0	102	0.750	2.490	226.78	120	95
8	5.0	105	0.500	1.650	230.55	122	96
7	5.0	102	0.450	1.490	234.20	121	96
6	5.0	101	0.680	2.270	238.38	120	97
5	5.0	100	0.770	2.570	242.90	123	97
4	5.0	87	0.770	2.630	247.51	125	98
3	5.0	108	0.430	1.420	251.03	125	99
2	5.0	106	0.430	1.430	254.51	123	99
1	5.0	107	0.300	0.990	257.51	121	99
1	5.0	107	0.520	1.700	261.25	96	93
2	5.0	107	0.530	1.740	265.07	105	94
3	5.0	104	0.570	1.880	268.92	112	94
4	5.0	113	0.480	1.560	272.40	117	95
5	5.0	107	0.490	1.610	276.10	119	95
6	5.0	103	0.510	1.690	279.76	119	96
7	5.0	103	0.480	1.590	283.37	120	97
8	5.0	95	0.600	2.020	287.37	121	97
9	5.0	105	0.500	1.660	291.11	123	98
10	5.0	105	0.530	1.760	294.90	123	98
11	5.0	105	0.550	1.830	298.76	124	99
12	5.0	106	0.640	2.130	302.89	124	100
13	5.0	107	0.600	1.990	306.94	126	100
14	5.0	107	0.600	1.990	310.96	127	101
15	5.0	109	0.530	1.750	314.79	127	101
16	5.0	107	0.520	1.730	318.58	127	101
17	5.0	102	0.540	1.810	322.49	127	102
18	5.0	103	0.530	1.780	326.30	127	102
19	5.0	101	0.510	1.710	330.10	127	102
20	5.0	100	0.530	1.790	333.92	127	103
21	5.0	106	0.530	1.770	337.66	127	103
21	5.0	102	0.530	1.780	341.48	127	103
21	5.0	102	0.530	1.780	345.30	127	103
21	5.0	106	0.510	1.700	349.09	128	103
AVERAGE		104		1.761		116	94

AVE. TEMPERATURE = 40.0 DEG. C

TOTAL SAMPLE TIME = 240.0 MIN.

TOTAL SAMPLE VOLUME = 149.101 SCF OR 4.223 SCM

SAMPLING DATA

BAROMETRIC PRESSURE (IN.HG.)	26.56	OR	674.62	MM HG
PITOT TUBE FACTOR	0.734			
METER CALIBRATION FACTOR	0.973			
NOZZLE DIAMETER (IN.)	0.250	OR	6.350	MM
WT. OF PART. IN PROBE WASH (GM)	0.06680			
WT. OF PART. ON FILTER (GM)	0.14260			
WATER COLLECTED IN IMPINGERS (ML)	283.6			

ANALYSIS OF ISOKINETICITY

TRAVERSE PT.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
21	5.0	0.0115	0.0114	100.9
21	5.0	0.0131	0.0134	98.0
21	5.0	0.0124	0.0122	101.6
21	5.0	0.0120	0.0121	99.2
20	5.0	0.0116	0.0115	100.9
19	5.0	0.0114	0.0115	99.5
18	5.0	0.0121	0.0123	98.4
17	5.0	0.0122	0.0124	98.6
16	5.0	0.0123	0.0123	99.9
15	5.0	0.0136	0.0139	97.5
14	5.0	0.0143	0.0146	98.0
13	5.0	0.0146	0.0149	98.0
12	5.0	0.0163	0.0168	97.4
11	5.0	0.0161	0.0164	98.1
10	5.0	0.0123	0.0122	101.1
9	5.0	0.0154	0.0160	95.9
8	5.0	0.0133	0.0131	101.5
7	5.0	0.0126	0.0124	103.4
6	5.0	0.0147	0.0153	96.4
5	5.0	0.0159	0.0162	97.7
4	5.0	0.0158	0.0160	98.3
3	5.0	0.0124	0.0122	101.9
2	5.0	0.0123	0.0122	100.7
1	5.0	0.0106	0.0102	104.1
1	5.0	0.0136	0.0134	101.5
2	5.0	0.0138	0.0135	101.8
3	5.0	0.0137	0.0140	98.1
4	5.0	0.0125	0.0130	96.6
5	5.0	0.0132	0.0130	101.2
6	5.0	0.0129	0.0132	97.7
7	5.0	0.0127	0.0128	99.1
8	5.0	0.0139	0.0143	97.6
9	5.0	0.0132	0.0131	100.5
10	5.0	0.0134	0.0135	98.9
11	5.0	0.0136	0.0138	98.7
12	5.0	0.0146	0.0149	98.0
13	5.0	0.0143	0.0144	99.1
14	5.0	0.0142	0.0144	98.2
15	5.0	0.0135	0.0136	99.7
16	5.0	0.0133	0.0134	99.4
17	5.0	0.0136	0.0136	100.1
18	5.0	0.0133	0.0135	98.6
19	5.0	0.0132	0.0132	100.0
20	5.0	0.0133	0.0135	98.5
21	5.0	0.0131	0.0135	96.9
21	5.0	0.0133	0.0135	98.6
21	5.0	0.0133	0.0135	98.6
21	5.0	0.0133	0.0133	100.0

AVERAGE PERCENT ISOKINETICITY ACHIEVED 99.1

FLOW CONDITIONS DURING TEST

STACK AREA FT2	69.64	OR	6.47	SQR M
ABS. STACK PRESS.(IN. HG.)	26.52	OR	673.65	MM HG
STACK GAS DRY MOL. WT.	29.09			
AVG. STACK GAS VELOCITY(FPS)	39.49	OR	12.04	M/S
GAS FLOW(ACFM-DRY)	151224	OR	4283	ACM/M
GAS FLOW(SCFM-DRY)	127632	OR	3615	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O2	18.95	17.36
CO2	1.95	1.79
CO	0.00	0.00
N2	79.18	72.56
H2O		8.37

SPECIFIC GRAVITY OF FLUE GAS(AIR=1.0) 0.97

PARTICULATE EMISSION RATE

LBS/SCF	3.097E-06	OR	4.960E-02	GM/SCM
LBS/ACF	2.395E-06	OR	3.836E-02	GM/ACM
GRAINS/SCF	2.168E-02			
GRAINS/SCF (12% CO2)	1.334E-01			
EXCESS AIR (PERCENT)	897.30			
GRAINS/SCF AT 50% EA	1.466E-01			
GRAINS/ACF	1.676E-02			
LBS/HR	2.371E+01	OR	1.076E+01	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY

BULLMOOSE COAL PREP. PLANT, TUMBLER RIDGE

AUG.29/84 13:00-17:46 DIOX#1 DF-1

TRAVERSE DATA

TRAVERSE PT.	SAMPLE TIME (MIN)	STACK GAS TEMP (DEG. F)	VELOCITY PRESSURE (IN. H2O)	ORIFICE PRESSURE (IN. H2O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEG. F) IN	GAS METER TEMP (DEG. F) OUT
					164.99		
1	5.0	116	0.230	0.770	167.71	95	92
2	5.0	116	0.250	0.840	170.46	102	92
3	5.0	116	0.280	0.940	173.40	109	91
4	5.0	115	0.290	0.980	176.40	115	92
5	5.0	111	0.290	0.950	179.44	118	94
6	5.0	110	0.290	0.990	182.46	120	95
7	5.0	113	0.310	1.040	185.57	122	95
8	5.0	111	0.280	0.960	188.57	123	98
9	5.0	112	0.290	1.000	191.64	125	99
10	5.0	108	0.330	1.150	194.86	127	100
11	5.0	110	0.360	1.240	198.21	128	101
12	5.0	110	0.390	1.350	201.73	129	101
13	5.0	110	0.490	1.690	205.69	130	102
14	5.0	111	0.480	1.660	209.46	133	103
15	5.0	107	0.300	1.040	212.77	133	106
16	5.0	104	0.650	2.280	217.18	133	105
17	5.0	106	0.330	1.160	220.53	133	107
18	5.0	103	0.550	1.940	224.65	134	107
19	5.0	103	0.520	1.830	228.80	136	106
20	5.0	105	0.580	2.040	233.02	136	107
21	5.0	103	0.660	2.340	237.59	137	109
22	5.0	105	0.700	2.460	242.26	136	110
23	5.0	106	0.700	2.470	246.90	135	110
24	5.0	97	0.750	2.690	251.57	136	110
24	5.0	110	0.670	2.300	256.17	108	97
23	5.0	105	0.700	2.410	260.76	114	98
22	5.0	100	0.770	2.690	265.65	121	99
21	5.0	104	0.700	2.450	270.35	125	100
20	5.0	108	0.450	1.560	274.15	129	101
19	5.0	109	0.480	1.660	277.99	127	102
18	5.0	105	0.490	1.700	281.85	128	102
17	5.0	104	0.580	2.060	286.19	129	103
16	5.0	110	0.590	2.050	290.35	131	104
15	5.0	106	0.490	1.710	294.31	132	105
14	5.0	108	0.500	1.740	298.39	132	105
13	5.0	101	0.540	1.910	302.57	132	107
12	5.0	98	0.550	1.960	306.75	134	107
11	5.0	104	0.460	1.690	310.64	134	108
10	5.0	105	0.420	1.480	314.34	134	108
9	5.0	107	0.410	1.440	317.99	134	109
8	5.0	97	0.460	1.650	321.79	134	109
7	5.0	105	0.420	1.480	325.56	133	109
6	5.0	102	0.430	1.530	329.30	133	110
5	5.0	105	0.410	1.450	332.99	134	109
4	5.0	99	0.450	1.610	336.81	134	109
3	5.0	105	0.420	1.480	340.52	134	109
2	5.0	102	0.430	1.530	344.27	133	109
1	5.0	105	0.330	1.170	347.62	133	109
AVERAGE		106		1.633		128	103

AVG. TEMPERATURE = 41.3 DEG. C

TOTAL SAMPLE TIME = 140.0 MIN.

TOTAL SAMPLE VOLUME = 146.552 SCF OR 4.163 SCM

SAMPLING DATA

BAROMETRIC PRESSURE (IN.HG.)	26.45	OR	671.83	MM HG
PITOT TUBE FACTOR	0.774			
METER CALIBRATION FACTOR	0.971			
NOZZLE DIAMETER (IN.)	0.250	OR	6.350	MM
WT. OF PART. IN PROBE WASH (GM)	0.00000			
WT. OF PART. ON FILTER (GM)	0.00000			
WATER COLLECTED IN IMPINGERS (ML)	330.6			

ANALYSIS OF ISOKINETICITY

TRAVERSE PT.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
1	5.0	0.0102	0.0095	107.0
2	5.0	0.0102	0.0099	103.1
3	5.0	0.0109	0.0105	103.6
4	5.0	0.0110	0.0107	103.2
5	5.0	0.0110	0.0106	103.7
6	5.0	0.0109	0.0106	102.7
7	5.0	0.0113	0.0110	102.4
8	5.0	0.0108	0.0105	103.3
9	5.0	0.0110	0.0107	103.7
10	5.0	0.0115	0.0113	101.4
11	5.0	0.0120	0.0118	101.1
12	5.0	0.0126	0.0123	102.0
13	5.0	0.0141	0.0138	102.2
14	5.0	0.0134	0.0137	98.1
15	5.0	0.0117	0.0108	108.1
16	5.0	0.0155	0.0158	98.0
17	5.0	0.0118	0.0113	104.2
18	5.0	0.0144	0.0146	99.1
19	5.0	0.0145	0.0141	102.5
20	5.0	0.0148	0.0150	98.7
21	5.0	0.0159	0.0159	100.0
22	5.0	0.0164	0.0164	99.4
23	5.0	0.0163	0.0165	99.0
24	5.0	0.0161	0.0169	95.5
24	5.0	0.0168	0.0162	104.2
23	5.0	0.0166	0.0164	101.1
22	5.0	0.0173	0.0172	100.6
21	5.0	0.0167	0.0164	101.6
20	5.0	0.0135	0.0132	102.3
19	5.0	0.0137	0.0137	100.3
18	5.0	0.0136	0.0138	99.8
17	5.0	0.0153	0.0150	102.6
16	5.0	0.0148	0.0152	97.7
15	5.0	0.0140	0.0138	101.5
14	5.0	0.0144	0.0139	103.7
13	5.0	0.0146	0.0144	101.4
12	5.0	0.0145	0.0145	100.1
11	5.0	0.0136	0.0136	100.1
10	5.0	0.0130	0.0127	101.6
9	5.0	0.0128	0.0126	101.7
8	5.0	0.0131	0.0132	99.1
7	5.0	0.0132	0.0127	103.7
6	5.0	0.0130	0.0129	101.3
5	5.0	0.0129	0.0126	102.7
4	5.0	0.0132	0.0131	100.9
3	5.0	0.0130	0.0127	102.0
2	5.0	0.0131	0.0129	101.7
1	5.0	0.0117	0.0113	103.9

AVERAGE PERCENT ISOKINETICITY ACHIEVED 101.4

FLOW CONDITIONS DURING TEST

STACK AREA FT2	69.64	OR	6.47	SQR M
ABS. STACK PRESS.(IN. HG.)	26.43	OR	671.23	MM HG
STACK GAS DRY MOL. WT.	29.13			
AVG. STACK GAS VELOCITY(FPS)	38.94	OR	11.87	M/S
GAS FLOW(ACFM-DRY)	146847	OR	4159	ACM/M
GAS FLOW(SCFM-DRY)	122975	OR	3483	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O2	18.37	16.58
CO2	2.47	2.23
CO	0.00	0.00
N2	79.16	71.45
H2O		9.74

SPECIFIC GRAVITY OF FLUE GAS(AIR=1.0) 0.97

PARTICULATE EMISSION RATE

LBS/SCF	0.000E+00	OR	0.000E+00	GM/SCM
LBS/ACF	0.000E+00	OR	0.000E+00	GM/ACM
GRAINS/SCF	0.000E+00			
GRAINS/SCF (12% CO2)	0.000E+00			
EXCESS AIR (PERCENT)	683.77			
GRAINS/SCF AT 50% EA	0.000E+00			
GRAINS/ACF	0.000E+00			
LBS/HR	0.000E+00	OR	0.000E+00	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY

BULLMOOSE COAL PREP. PLANT, TUMBLER RIDGE

AUG.30/84 10:18-16:20 DIGX#2 DF-2

TRAVERSE DATA

TRAVERSE PT.	SAMPLE TIME (MIN)	STACK GAS TEMP (DEG. F)	VELOCITY PRESSURE (IN. H2O)	ORIFICE PRESSURE (IN. H2O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEG. F) IN	GAS METER TEMP (DEG. F) OUT
					352.39		
24	5.0	106	0.650	2.110	356.63	88	82
23	5.0	108	0.600	1.940	360.71	98	83
22	5.0	108	0.570	1.850	364.72	106	85
21	5.0	105	0.600	1.970	368.85	112	87
20	5.0	107	0.550	1.800	372.83	116	88
19	5.0	104	0.620	2.050	377.04	119	90
18	5.0	106	0.550	1.820	381.07	121	92
17	5.0	106	0.650	2.160	385.57	123	94
16	5.0	103	0.500	1.670	389.45	109	95
15	5.0	104	0.680	2.270	393.91	117	95
14	5.0	105	0.650	2.170	398.30	123	96
13	5.0	102	0.670	2.250	402.77	125	97
12	5.0	104	0.550	1.850	406.94	126	99
11	5.0	108	0.500	1.670	410.81	127	100
10	5.0	103	0.520	1.760	414.78	127	101
9	5.0	102	0.520	1.760	418.74	128	102
8	5.0	108	0.450	1.450	422.38	94	90
7	5.0	108	0.450	1.480	426.00	99	90
6	5.0	105	0.480	1.590	429.76	108	91
5	5.0	102	0.460	1.530	433.46	112	91
4	5.0	104	0.480	1.600	437.22	117	93
3	5.0	105	0.470	1.560	440.95	119	93
2	5.0	102	0.480	1.610	444.75	122	95
1	5.0	102	0.440	1.470	448.40	123	96
1	5.0	105	0.320	1.070	451.57	100	95
2	5.0	105	0.310	1.030	454.63	99	95
3	5.0	108	0.290	0.960	457.61	108	96
4	5.0	105	0.290	0.970	460.60	113	96
5	5.0	105	0.270	0.900	463.52	116	97
6	5.0	104	0.300	1.010	466.57	118	98
7	5.0	105	0.270	0.910	469.50	120	99
8	5.0	98	0.300	1.020	472.57	122	100
9	5.0	100	0.290	0.960	475.59	123	101
10	5.0	99	0.400	1.360	479.07	123	102
11	5.0	98	0.420	1.440	482.70	126	103
12	5.0	104	0.500	1.690	486.55	128	103
13	5.0	99	0.720	2.460	491.15	130	104
14	5.0	102	0.680	2.320	495.75	134	106
15	5.0	101	0.650	2.230	500.47	136	107
16	5.0	103	0.480	1.640	504.21	136	108
17	5.0	103	0.490	1.680	508.13	136	108
18	5.0	102	0.640	2.190	512.51	136	108
19	5.0	104	0.540	1.850	516.65	136	109
20	5.0	102	0.710	2.440	521.32	136	110
21	5.0	105	0.650	2.220	525.85	138	110
22	5.0	95	1.020	3.550	531.35	139	111
23	5.0	106	0.640	2.190	535.96	139	111
24	5.0	104	0.590	2.030	540.32	140	112
AVERAGE		104		1.737		120	98

AVE. TEMPERATURE = 39.7 DEG. C

TOTAL SAMPLE TIME = 240.0 MIN.

TOTAL SAMPLE VOLUME = 152.831 SCF OR 4.328 SCM

SAMPLING DATA

BAROMETRIC PRESSURE (IN.HG.)	26.43	OR	671.32	MM HG
PITOT TUBE FACTOR	0.774			
METER CALIBRATION FACTOR	0.971			
NOZZLE DIAMETER (IN.)	0.250	OR	6.350	MM
WT. OF PART. IN PROBE WASH (GM)	0.00000			
WT. OF PART. ON FILTER (GM)	0.00000			
WATER COLLECTED IN IMPINGERS(ML)	248.8			

ANALYSIS OF ISOKINETICITY

TRAVERSE PT.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
24	5.0	0.0155	0.0158	98.0
23	5.0	0.0146	0.0152	97.2
22	5.0	0.0144	0.0148	97.1
21	5.0	0.0147	0.0152	96.5
20	5.0	0.0141	0.0146	96.9
19	5.0	0.0146	0.0154	95.9
18	5.0	0.0141	0.0145	97.2
17	5.0	0.0157	0.0158	99.6
16	5.0	0.0136	0.0138	98.7
15	5.0	0.0156	0.0161	96.8
14	5.0	0.0153	0.0158	96.9
13	5.0	0.0155	0.0160	96.7
12	5.0	0.0144	0.0145	99.4
11	5.0	0.0135	0.0139	96.9
10	5.0	0.0137	0.0141	96.9
9	5.0	0.0136	0.0141	96.4
8	5.0	0.0131	0.0132	99.7
7	5.0	0.0130	0.0132	98.7
6	5.0	0.0133	0.0136	98.2
5	5.0	0.0130	0.0133	98.1
4	5.0	0.0132	0.0136	97.1
3	5.0	0.0131	0.0134	97.3
2	5.0	0.0132	0.0135	97.4
1	5.0	0.0126	0.0130	97.5
1	5.0	0.0113	0.0111	101.6
2	5.0	0.0109	0.0109	99.7
3	5.0	0.0106	0.0106	99.7
4	5.0	0.0105	0.0106	99.4
5	5.0	0.0102	0.0102	100.2
6	5.0	0.0106	0.0107	99.0
7	5.0	0.0102	0.0102	100.0
8	5.0	0.0105	0.0107	98.6
9	5.0	0.0104	0.0105	98.6
10	5.0	0.0119	0.0123	96.7
11	5.0	0.0124	0.0126	98.0
12	5.0	0.0132	0.0138	95.7
13	5.0	0.0157	0.0165	94.8
14	5.0	0.0157	0.0161	97.3
15	5.0	0.0160	0.0157	101.7
16	5.0	0.0127	0.0136	93.7
17	5.0	0.0133	0.0137	97.2
18	5.0	0.0149	0.0156	95.1
19	5.0	0.0141	0.0144	97.9
20	5.0	0.0158	0.0165	96.2
21	5.0	0.0154	0.0158	97.5
22	5.0	0.0184	0.0196	93.9
23	5.0	0.0157	0.0157	99.9
24	5.0	0.0147	0.0150	98.1

AVERAGE PERCENT ISOKINETICITY ACHIEVED 97.5

FLOW CONDITIONS DURING TEST

STACK AREA FT2	69.64	OR	6.47	SQR M
ABS. STACK PRESS.(IN. HG.)	26.40	OR	670.44	MM HG
STACK GAS DRY MOL. WT.	29.07			
AVG. STACK GAS VELOCITY(FPS)	40.79	OR	12.43	M/S
GAS FLOW(ACFM-DRY)	158098	OR	4477	ACM/M
GAS FLOW(SCFM-DRY)	132910	OR	3764	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O2	18.74	17.38
CO2	1.98	1.84
CO	0.00	0.00
N2	79.28	73.53
H2O		7.25

SPECIFIC GRAVITY OF FLUE GAS(AIR=1.0) 0.98

PARTICULATE EMISSION RATE

LBS/SCF	0.000E+00	OR	0.000E+00	GM/SCM
LBS/ACF	0.000E+00	OR	0.000E+00	GM/ACM
GRAINS/SCF	0.000E+00			
GRAINS/SCF (12% CO2)	0.000E+00			
EXCESS AIR (PERCENT)	797.96			
GRAINS/SCF AT 50% EA	0.000E+00			
GRAINS/ACF	0.000E+00			
LBS/HR	0.000E+00	OR	0.000E+00	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY

BULLMOOSE COAL PREP. PLANT, TUMBLER RIDGE

AUG.31/84 9:46-14:00 EIOX#3 DF-3

TRAVERSE DATA

TRAVERSE PT.	SAMPLE TIME (MIN)	STACK GAS TEMP (DEG. F)	VELOCITY PRESSURE (IN. H2O)	ORIFICE PRESSURE (IN. H2O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEG. F) IN	GAS METER TEMP (DEG. F) OUT
					544.13		
1	5.0	102	0.320	1.070	547.21	88	83
2	5.0	101	0.320	1.070	550.30	94	83
3	5.0	104	0.320	1.000	553.38	101	84
4	5.0	104	0.300	1.000	556.41	105	85
5	5.0	103	0.310	1.040	559.48	109	86
6	5.0	100	0.310	1.050	562.57	113	88
7	5.0	100	0.300	1.020	565.64	115	89
8	5.0	100	0.300	1.020	568.71	117	91
9	5.0	101	0.300	1.020	571.78	119	93
10	5.0	103	0.350	1.200	575.13	121	95
11	5.0	105	0.330	1.120	578.38	122	96
12	5.0	102	0.430	1.470	582.07	124	98
13	5.0	99	0.520	1.790	586.08	126	99
14	5.0	101	0.570	1.970	590.27	128	101
15	5.0	98	0.600	2.090	594.59	130	102
16	5.0	101	0.380	1.240	598.06	130	103
17	5.0	98	0.430	1.510	601.83	129	104
18	5.0	100	0.450	1.570	605.65	130	104
19	5.0	96	0.700	2.460	610.34	131	104
20	5.0	100	0.520	1.820	614.46	132	106
20	5.0	100	0.600	2.270	618.98	132	107
22	5.0	102	0.710	2.480	623.73	135	107
23	5.0	101	0.760	2.730	628.72	136	108
24	5.0	103	0.730	2.550	633.56	137	109
24	5.0	102	0.570	1.980	637.79	109	104
23	5.0	101	0.570	1.980	641.99	113	104
22	5.0	104	0.550	1.900	646.11	120	104
21	5.0	108	0.460	1.580	649.92	125	104
20	5.0	105	0.460	1.580	653.71	128	104
19	5.0	103	0.500	1.730	657.65	129	104
18	5.0	105	0.480	1.660	661.52	131	105
17	5.0	103	0.490	1.700	665.43	131	106
16	5.0	104	0.600	2.080	669.65	133	107
15	5.0	101	0.580	2.020	673.93	134	107
14	5.0	98	0.690	2.420	678.57	135	107
13	5.0	105	0.620	2.150	683.02	137	108
12	5.0	98	0.640	2.250	687.53	138	108
11	5.0	108	0.550	1.900	691.73	139	110
10	5.0	103	0.520	1.820	695.83	137	110
9	5.0	100	0.520	1.830	699.91	137	110
8	5.0	100	0.460	1.620	703.81	136	111
7	5.0	101	0.470	1.650	707.69	136	111
6	5.0	104	0.440	1.540	711.50	136	111
5	5.0	102	0.430	1.510	715.24	136	111
4	5.0	100	0.440	1.550	719.01	135	111
3	5.0	99	0.400	1.410	722.64	135	111
2	5.0	98	0.400	1.410	726.25	134	111
1	5.0	94	0.380	1.350	729.81	134	111
AVERAGE		101		1.667		126	102

AVG. TEMPERATURE = 38.5 DEG. C

TOTAL SAMPLE TIME = 240.0 MIN.

TOTAL SAMPLE VOLUME = 148.893 SCF OR 4.217 SCM

SAMPLING DATA

BAROMETRIC PRESSURE (IN.HG.)	26.29	OR	667.77	MM HG
PITOT TUBE FACTOR	0.774			
METER CALIBRATION FACTOR	0.971			
NOZZLE DIAMETER (IN.)	0.250	OR	6.350	MM
WT. OF PART. IN PROBE WASH (GM)	0.00000			
WT. OF PART. ON FILTER (GM)	0.00000			
WATER COLLECTED IN IMPINGERS (ML)	372.1			

ANALYSIS OF ISOKINETICITY

TRAVERSE PT.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
1	5.0	0.0116	0.0112	103.6
2	5.0	0.0115	0.0112	103.1
3	5.0	0.0114	0.0112	102.3
4	5.0	0.0112	0.0108	103.5
5	5.0	0.0113	0.0110	102.6
6	5.0	0.0112	0.0110	102.5
7	5.0	0.0111	0.0108	103.2
8	5.0	0.0111	0.0108	102.8
9	5.0	0.0111	0.0108	102.5
10	5.0	0.0121	0.0117	103.5
11	5.0	0.0117	0.0114	103.4
12	5.0	0.0132	0.0129	102.3
13	5.0	0.0143	0.0142	100.6
14	5.0	0.0149	0.0149	100.3
15	5.0	0.0153	0.0152	100.3
16	5.0	0.0123	0.0122	101.2
17	5.0	0.0133	0.0129	103.1
18	5.0	0.0135	0.0132	102.3
19	5.0	0.0165	0.0164	100.5
20	5.0	0.0145	0.0142	102.3
20	5.0	0.0160	0.0153	104.5
22	5.0	0.0168	0.0166	101.0
23	5.0	0.0176	0.0174	101.0
24	5.0	0.0171	0.0169	101.2
24	5.0	0.0153	0.0149	102.8
23	5.0	0.0151	0.0149	101.6
22	5.0	0.0148	0.0147	101.1
21	5.0	0.0137	0.0135	102.0
20	5.0	0.0136	0.0134	101.0
19	5.0	0.0140	0.0140	100.5
18	5.0	0.0138	0.0137	100.6
17	5.0	0.0139	0.0138	100.4
16	5.0	0.0150	0.0153	97.8
15	5.0	0.0151	0.0150	100.5
14	5.0	0.0163	0.0163	99.7
13	5.0	0.0158	0.0156	101.1
12	5.0	0.0158	0.0157	100.2
11	5.0	0.0149	0.0147	101.2
10	5.0	0.0144	0.0142	101.3
9	5.0	0.0143	0.0142	100.5
8	5.0	0.0136	0.0134	102.1
7	5.0	0.0136	0.0135	100.6
6	5.0	0.0134	0.0131	102.4
5	5.0	0.0131	0.0129	101.4
4	5.0	0.0132	0.0131	101.0
3	5.0	0.0127	0.0124	101.9
2	5.0	0.0126	0.0124	101.3
1	5.0	0.0123	0.0121	102.1

AVERAGE PERCENT ISOKINETICITY ACHIEVED 101.4

FLOW CONDITIONS DURING TEST

STACK AREA FT2	69.64	OR	6.47	SQR M
ABS. STACK PRESS.(IN. HG.)	26.26	OR	667.02	MM HG
STACK GAS DRY MOL. WT.	29.04			
AVG. STACK GAS VELOCITY(FPS)	39.70	OR	12.10	M/S
GAS FLOW(ACFM-DRY)	148131	OR	4195	ACM/M
GAS FLOW(SCFM-DRY)	124395	OR	3523	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O2	18.90	16.88
CO2	1.77	1.58
CO	0.00	0.00
N2	79.33	70.83
H2O		10.71

SPECIFIC GRAVITY OF FLUE GAS(AIR=1.0) 0.96

PARTICULATE EMISSION RATE

LBS/SCF	0.000E+00	OR	0.000E+00	GM/SCM
LBS/ACF	0.000E+00	OR	0.000E+00	GM/ACM
GRAINS/SCF	0.000E+00			
GRAINS/SCF (12% CO2)	0.000E+00			
EXCESS AIR (PERCENT)	858.40			
GRAINS/SCF AT 50% EA	0.000E+00			
GRAINS/ACF	0.000E+00			
LBS/HR	0.000E+00	OR	0.000E+00	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY

BULLMOOSE COAL PREP. PLANT, TUMBLER RIDGE

SEPT.1/84 10:11-14:30 PAR#1 PAH/PCB -1

TRAVERSE DATA

TRAVERSE PT.	SAMPLE TIME (MIN)	STACK GAS TEMP (DEG. F)	VELOCITY PRESSURE (IN. H2O)	ORIFICE PRESSURE (IN. H2O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEG. F) IN	OUT
					736.59		
1	5.0	108	0.390	1.300	740.00	83	79
2	5.0	105	0.450	1.510	743.61	89	80
3	5.0	90	0.460	1.660	747.36	97	81
4	5.0	107	0.480	1.610	751.15	103	82
5	5.0	104	0.480	1.620	754.88	110	83
6	5.0	107	0.430	1.450	758.46	112	84
7	5.0	105	0.500	1.700	762.31	115	86
8	5.0	101	0.510	1.750	766.23	118	89
9	5.0	104	0.530	1.830	770.26	119	90
10	5.0	108	0.690	2.400	774.86	122	92
11	5.0	108	0.700	2.400	779.48	123	94
12	5.0	98	0.720	2.540	784.23	126	95
13	5.0	100	0.700	2.400	788.89	127	96
14	5.0	108	0.600	2.080	793.22	127	97
15	5.0	104	0.610	2.120	797.55	129	99
16	5.0	98	0.450	1.590	801.36	127	100
17	5.0	108	0.300	1.040	804.49	125	99
18	5.0	107	0.500	1.730	808.44	124	100
19	5.0	106	0.480	1.670	812.30	126	100
20	5.0	109	0.380	1.310	815.87	124	100
21	5.0	106	0.650	2.260	820.34	125	100
22	5.0	106	0.620	2.150	824.74	127	101
23	5.0	106	0.400	1.400	828.37	127	102
24	5.0	105	0.580	2.030	832.66	126	102
24	5.0	107	0.560	1.930	836.68	98	95
23	5.0	95	0.580	2.040	841.04	103	96
22	5.0	98	0.570	1.990	845.04	111	94
21	5.0	98	0.530	1.650	849.08	117	94
20	5.0	100	0.560	1.960	853.22	121	97
19	5.0	93	0.590	2.090	857.48	123	97
18	5.0	93	0.580	2.060	861.73	125	98
17	5.0	88	0.610	2.180	866.09	126	98
16	5.0	97	0.630	2.220	870.59	128	99
15	5.0	96	0.670	2.370	875.10	128	100
14	5.0	101	0.670	2.350	879.66	128	101
13	5.0	101	0.440	1.550	883.45	129	102
12	5.0	101	0.640	2.250	887.83	129	101
11	5.0	101	0.620	2.180	892.25	127	102
10	5.0	100	0.570	2.010	896.51	126	101
9	5.0	101	0.540	1.900	900.84	126	101
8	5.0	104	0.520	1.820	904.70	129	102
7	5.0	107	0.470	1.630	908.57	128	101
6	5.0	105	0.480	1.670	912.43	128	101
5	5.0	102	0.480	1.680	916.29	128	101
4	5.0	107	0.440	1.530	920.00	127	102
3	5.0	104	0.440	1.540	923.74	127	102
2	5.0	101	0.410	1.440	927.37	127	102
1	5.0	104	0.380	1.330	930.89	126	101
AVERAGE		102		1.853		121	96

AVG. TEMPERATURE = 35.0 DEG. C

TOTAL SAMPLE TIME = 240.0 MIN.

TOTAL SAMPLE VOLUME = 157.596 SCF OR 4.463 SCM

SAMPLING DATA

BAROMETRIC PRESSURE (IN.HG.)	26.31	OR	668.27	MM HG
PITOT TUBE FACTOR	0.774			
METER CALIBRATION FACTOR	0.971			
NOZZLE DIAMETER (IN.)	0.250	OR	6.350	MM
WT. OF PART. IN PROBE WASH (GM)	0.00000			
WT. OF PART. ON FILTER (GM)	0.00000			
WATER COLLECTED IN IMPINGERS (ML)	376.6			

ANALYSIS OF ISOKINETICITY

TRAVERSE PT.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
1	5.0	0.0130	0.0124	105.0
2	5.0	0.0136	0.0133	102.5
3	5.0	0.0136	0.0135	100.9
4	5.0	0.0141	0.0137	102.9
5	5.0	0.0137	0.0137	100.3
6	5.0	0.0132	0.0130	101.6
7	5.0	0.0141	0.0140	100.6
8	5.0	0.0142	0.0141	100.7
9	5.0	0.0146	0.0144	101.7
10	5.0	0.0168	0.0165	101.8
11	5.0	0.0168	0.0166	101.3
12	5.0	0.0169	0.0167	101.4
13	5.0	0.0166	0.0165	100.9
14	5.0	0.0156	0.0153	101.8
15	5.0	0.0155	0.0154	100.2
16	5.0	0.0134	0.0132	102.1
17	5.0	0.0113	0.0109	103.7
18	5.0	0.0142	0.0140	101.5
19	5.0	0.0138	0.0137	101.0
20	5.0	0.0129	0.0122	105.3
21	5.0	0.0161	0.0159	100.7
22	5.0	0.0158	0.0156	101.4
23	5.0	0.0130	0.0125	103.7
24	5.0	0.0153	0.0150	101.9
24	5.0	0.0149	0.0146	100.4
23	5.0	0.0157	0.0149	105.3
22	5.0	0.0144	0.0148	97.2
21	5.0	0.0145	0.0143	101.2
20	5.0	0.0148	0.0147	100.5
19	5.0	0.0150	0.0150	100.0
18	5.0	0.0149	0.0149	100.3
17	5.0	0.0152	0.0152	99.9
16	5.0	0.0159	0.0156	102.0
15	5.0	0.0159	0.0160	99.0
14	5.0	0.0162	0.0161	100.4
13	5.0	0.0134	0.0131	102.6
12	5.0	0.0155	0.0158	98.6
11	5.0	0.0157	0.0155	101.2
10	5.0	0.0151	0.0149	101.5
9	5.0	0.0154	0.0145	106.1
8	5.0	0.0137	0.0142	96.5
7	5.0	0.0139	0.0136	102.1
6	5.0	0.0138	0.0137	100.6
5	5.0	0.0137	0.0137	100.4
4	5.0	0.0133	0.0131	101.1
3	5.0	0.0133	0.0131	101.7
2	5.0	0.0129	0.0126	102.0
1	5.0	0.0126	0.0122	103.1

AVERAGE PERCENT ISOKINETICITY ACHIEVED 101.2

FLOW CONDITIONS DURING TEST

STACK AREA FT2	69.64	OR	6.47	SQR M
ABS. STACK PRESS.(IN. HG.)	26.28	OR	667.51	MM HG
STACK GAS DRY MOL. WT.	29.04			
AVG. STACK GAS VELOCITY(FPS)	41.97	OR	12.79	M/S
GAS FLOW(ACFM-DRY)	157334	OR	4456	ACM/M
GAS FLOW(SCFM-DRY)	132005	OR	3738	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O2	19.08	17.12
CO2	1.74	1.56
CO	0.00	0.00
N2	79.18	71.03
H2O		10.29

SPECIFIC GRAVITY OF FLUE GAS(AIR=1.0) 0.96

PARTICULATE EMISSION RATE

LBS/SCF	0.000E+00	OR	0.000E+00	GM/SCM
LBS/ACF	0.000E+00	OR	0.000E+00	GM/ACM
GRAINS/SCF	0.000E+00			
GRAINS/SCF (12% CO2)	0.000E+00			
EXCESS AIR (PERCENT)	962.72			
GRAINS/SCF AT 50% EA	0.000E+00			
GRAINS/ACF	0.000E+00			
LBS/HR	0.000E+00	OR	0.000E+00	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY

RUN NO. 11 PAGE 1

BULLMOOSE COAL PREP. PLANT, TUMBLER RIDGE

SEPT.2/84 10:01-14:29 PAH#2 PAH/PCB-2

TRAVERSE DATA

TRAVERSE PT.	SAMPLE TIME (MIN.)	STACK GAS TEMP (DEG. F)	VELOCITY PRESSURE (IN. H2O)	ORIFICE PRESSURE (IN. H2O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEG. F) IN	OUT
					932.71		
24	5.0	109	0.600	1.990	936.88	80	76
23	5.0	100	0.650	2.190	941.20	90	76
22	5.0	106	0.580	1.930	945.26	98	78
21	5.0	104	0.620	2.050	949.45	104	80
20	5.0	109	0.510	1.710	953.29	107	82
19	5.0	104	0.540	1.830	957.28	112	83
18	5.0	100	0.600	2.050	961.45	116	85
17	5.0	92	0.580	2.020	965.62	118	87
16	5.0	104	0.520	1.780	969.60	120	89
15	5.0	88	0.700	2.460	974.26	121	91
14	5.0	103	0.700	2.430	978.89	124	93
13	5.0	102	0.500	1.730	982.85	125	95
12	5.0	101	0.550	1.910	986.95	124	96
11	5.0	109	0.550	1.890	991.05	125	97
10	5.0	105	0.550	1.910	995.15	125	99
9	5.0	103	0.490	1.710	999.09	127	100
8	5.0	103	0.550	1.910	1003.22	126	100
7	5.0	92	0.580	2.070	1007.45	127	100
6	5.0	107	0.470	1.640	1011.31	127	102
5	5.0	102	0.490	1.720	1015.23	126	102
4	5.0	98	0.580	2.050	1019.48	127	102
3	5.0	105	0.400	1.400	1023.12	129	103
2	5.0	102	0.400	1.400	1026.71	127	103
1	5.0	103	0.330	1.160	1030.01	126	103
1	5.0	106	0.370	1.280	1033.38	100	98
2	5.0	105	0.380	1.320	1036.83	103	97
3	5.0	104	0.430	1.490	1040.50	109	97
4	5.0	111	0.400	1.370	1043.86	116	97
5	5.0	106	0.400	1.390	1047.35	120	98
6	5.0	103	0.380	1.320	1050.79	123	98
7	5.0	100	0.410	1.440	1054.38	124	98
8	5.0	94	0.450	1.600	1058.14	125	100
9	5.0	104	0.460	1.600	1061.91	126	100
10	5.0	104	0.500	1.750	1065.84	128	101
11	5.0	104	0.550	1.930	1069.96	129	102
12	5.0	103	0.500	1.750	1074.22	130	102
13	5.0	105	0.710	2.490	1078.64	131	104
14	5.0	106	0.690	2.420	1083.29	132	104
15	5.0	106	0.400	1.400	1086.97	133	105
16	5.0	105	0.490	1.720	1090.98	133	105
17	5.0	100	0.760	2.700	1095.65	133	106
18	5.0	101	0.490	1.740	1099.68	134	106
19	5.0	99	0.720	2.560	1104.38	134	106
20	5.0	98	0.770	2.750	1109.31	135	107
21	5.0	105	0.630	2.220	1113.87	136	107
22	5.0	98	0.780	2.790	1118.78	137	109
23	5.0	101	0.750	2.670	1123.65	138	109
24	5.0	104	0.640	2.270	1128.21	138	109
AVERAGE		102		1.891		122	97

AVE. TEMPERATURE = 39.2 DEG. C

TOTAL SAMPLE TIME = 240.0 MIN.

TOTAL SAMPLE VOLUME = 159.714 SCF OR 4.523 SCM

SAMPLING DATA

BAROMETRIC PRESSURE	(IN.HG.)	26.57	OR	674.88	MM HG
PITOT TUBE FACTOR		0.774			
METER CALIBRATION FACTOR		0.971			
NOZZLE DIAMETER	(IN.)	0.250	OR	6.350	MM
WT. OF PART. IN PROBE WASH	(GM)	0.00000			
WT. OF PART. ON FILTER	(GM)	0.00000			
WATER COLLECTED IN IMPINGERS	(ML)	382.6			

ANALYSIS OF ISOKINETICITY

TRAVERSE PT.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
24	5.0	0.0160	0.0153	104.9
23	5.0	0.0162	0.0158	102.7
22	5.0	0.0153	0.0150	101.9
21	5.0	0.0156	0.0155	100.6
20	5.0	0.0143	0.0141	101.6
19	5.0	0.0147	0.0144	101.6
18	5.0	0.0151	0.0152	99.9
17	5.0	0.0145	0.0148	100.5
16	5.0	0.0144	0.0142	102.0
15	5.0	0.0164	0.0162	101.4
14	5.0	0.0167	0.0164	101.6
13	5.0	0.0142	0.0139	102.3
12	5.0	0.0147	0.0145	100.9
11	5.0	0.0148	0.0146	101.5
10	5.0	0.0147	0.0146	100.9
9	5.0	0.0140	0.0137	102.3
8	5.0	0.0147	0.0145	101.3
7	5.0	0.0148	0.0148	100.0
6	5.0	0.0138	0.0135	102.5
5	5.0	0.0135	0.0137	101.6
4	5.0	0.0150	0.0149	100.9
3	5.0	0.0129	0.0124	104.2
2	5.0	0.0127	0.0124	102.7
1	5.0	0.0117	0.0113	104.0
24	5.0	0.0124	0.0120	103.6
23	5.0	0.0126	0.0121	104.2
22	5.0	0.0133	0.0129	103.6
21	5.0	0.0123	0.0125	98.3
20	5.0	0.0126	0.0124	101.2
19	5.0	0.0123	0.0121	101.8
18	5.0	0.0126	0.0125	102.0
17	5.0	0.0132	0.0131	101.2
16	5.0	0.0135	0.0133	101.1
15	5.0	0.0140	0.0139	100.9
14	5.0	0.0147	0.0146	100.7
13	5.0	0.0151	0.0139	109.0
12	5.0	0.0157	0.0166	95.0
11	5.0	0.0166	0.0163	101.4
10	5.0	0.0131	0.0125	105.1
9	5.0	0.0142	0.0138	103.3
8	5.0	0.0164	0.0171	96.3
7	5.0	0.0142	0.0137	103.2
6	5.0	0.0165	0.0166	99.4
5	5.0	0.0172	0.0171	100.6
4	5.0	0.0161	0.0156	103.3
3	5.0	0.0171	0.0172	99.2
2	5.0	0.0170	0.0170	100.5
1	5.0	0.0160	0.0157	102.0

AVERAGE PERCENT ISOKINETICITY ACHIEVED 101.5